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Railway Age

DAILY EDITION

FIRST HALF OF 1923—No. 13 CHICAGO—THURSDAY, MARCH 15, 1923—NEW YORK SIXTY-EIGHTH YEAR

Published weekly by Simmons-Boardman Pub. Co., Woolworth Bldg., New York, N. Y. Subscription Price U. S., Canada and Mexico, $6.00; foreign countries (excepting daily editions), $8.00; single copies, 25c. Entered as second-class matter, January 30, 1918, at the post office at New York, N. Y., under the act of March 3, 1879. Daily edition application made at the post office at Chicago, Ill., for entry as second-class matter. Chicago office, Transportation Building.

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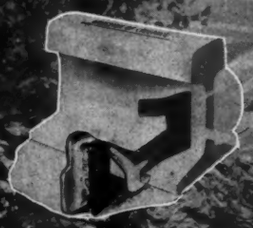

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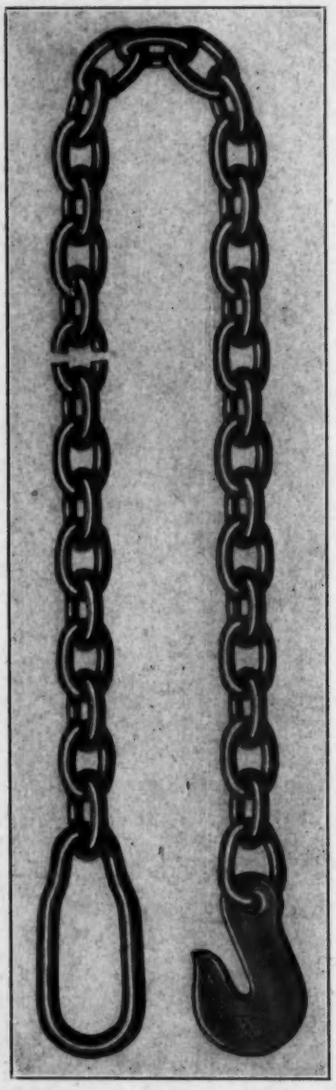

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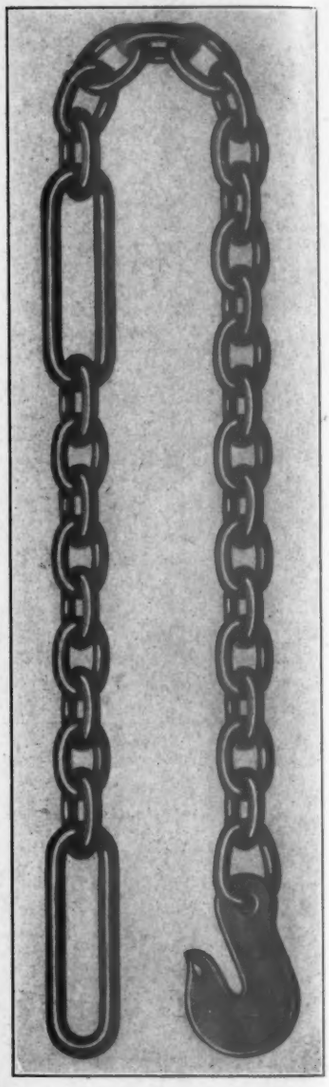

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Railway Age

EDITORIAL

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Contents

EDITORIALS

Economics of Signaling 663
Maintain the High Standard 663
Facilitating Train Operation at Interlockers 663
Specifications for Highway Bridges 664
A Standard Classification of Bridges 664
In Re: The Substitute Tie 664
Concrete Slab Foundations 664
The Engineer and Sanitation 665

MISCELLANEOUS

Heard Around the Conventions 665
A. R. E. A. Elects New Officers 702
A. R. E. A. Registration 703
Registration of Signal Section, A. R. A. 705
Engineering Association Holds Annual Dinner 706
A. R. E. A. Appoints Committee to Co-operate With Colleges 709

A. R. E. A. PROCEEDINGS

Report of the Committee on Ties 667
Report on Stresses in Track 670
Report on Economics of Railway Location 672
Memorial Service for Deceased Members 673
Report of the Committee on Track 674
Report of Committee on Rules and Organization 679
Report on Economics of Railway Labor 680
Report on Economics of Railway Operation 683
Report of the Committee on Roadway 690

SIGNAL SECTION PROCEEDINGS

Report of the Committee on Electrical Testing 692
American Engineering Standards Committee 695
Report on the Economics of Railway Signaling 696
Report of Committee on Standard Designs 701

NEW DEVICES

An Apron for Discharging Ballast 709
An Interesting Record of Motor Car Operation 710
A New Sand Dryer 710

Economics of Signaling

A signaling report, in the true sense of the word, has been produced by the Committee on Economics of Signaling of the Signal section, A.R.A. In contrast to the average report, which consists largely of specifications, this report illustrates, by means of diagrams, a plan by which the track capacity of single track can be increased 30 per cent by the operation of trains by signal indication. Preparatory to making this report the committee made an extensive field study of actual traffic conditions. In addition to the automatic blocks the signaling equipment is to consist of two interlocking plants, and power switch machines for all passing siding switches, controlled from the nearest station. The division is divided into four control sections whereby the movements of trains will be expedited and approximately 90 per cent of the present written train orders eliminated. There are numerous single track signal installations in successful operation, where railroad managements have the opportunity to investigate the possibilities of adapting signaling to their own problems of increasing track capacity, yet they are inclined in some cases to follow the old practice of double tracking. Of course, there are certain circumstances where double tracking is necessary but where the grade line is satisfactory there are many divisions where signaling will postpone the necessity of second track for years. This committee has investigated the results obtained on numerous roads and has prepared this plan for the benefit of roads seeking information on the subject of signaling single tracks. In fact, the committee offers to assist any road in determining the adapability of signals in solving the capacity problems of single track divisions.

Maintain the High Standard

Few visitors at the supply exhibit realize how much work must be done for months preceding the opening date to insure a successful show. The association is to be congratulated on the final result and deserves much credit for the thought and efforts which have made it possible. The present exhibit is the fifteenth, and if each exhibitor who occupies a booth had made his arrangements with the background of experience in the 14 previous exhibitions, the problem of the secretary and the executive committee would be relatively simple. But this is far from the fact. There are new exhibitors each year who require no little guidance in planning their displays. There are further problems. Each applicant for space must be investigated, not only as to his ability to pay for the space, but as to the character of his business, to insure that he is conducting a legitimate enterprise in the distribution of railway appliances and not a stock selling game. The association has been especially careful in this regard and with few exceptions has always succeeded in keeping out the fly-by-night concern. Too much emphasis cannot be placed on this phase of the association's problems, for with the great demand for space it would be very unfortunate if a legitimate concern were kept out when space was occupied by a company of questionable character.

Facilitating Train Operation at Interlockers

Many train delays and sometimes derailments and collisions at interlocking plants are caused by the towermen not knowing what to do under certain circumstances, as, for example, when a train locks up a route by overrunning a signal. Electric locks, time releases, etc., may be provided to safeguard conflicting train movements and if properly manipulated will permit the trains to proceed with safety under signal protection, with the least possible delay. Without proper instructions a new towerman, not acquainted with the layout or operation of the plant, may be inclined to "highball" the train with hand signals without checking the position of the derails or switches, instead of operating the machine properly. Again, the signal apparatus or switch connections may have been damaged, which would require that certain precautions be taken

on the part of the leverman. As a rule the levermen, particularly when they are operators, are under the jurisdiction of the operating department, but the signal department has the responsibility for explaining train delays. Many roads have issued rules and instructions for towermen. However, the new instructions to levermen concerning the handling of interlocking plants, as given and Instructions of the Signal section, include many of and Instructions of the Signal section, includes many of the important details that may be understood readily by the average leverman and allows few chances for the excuse that he did not know what should be done in such a case. With these new instructions at hand the signal officers should, in defense of their own employees and equipment, proceed to interest the operating officers in establishing these instructions in order that train operation at interlockers may be expedited with safety.

Specifications for Highway Bridges

One need go no further for a measure of progress in highway bridge construction than to recall the sign which adorned every wooden and steel span of the past. "Ten dollars for crossing this bridge faster than a walk." This traditional "slow order" pictures a status of bridge design and construction which stands out in sharp contrast to the requirements under the rule of highway traffic speeds which prevail today. Any period of rapid development or expansion such as has been experienced in highway construction during the last 15 years is necessarily one of changing standards, inconsistencies and confusion. In these days of increasing wheel loads for motor vehicles which perplex alike the designer of the roadway and the designer of the bridge, current practices vary widely in different communities. Railroads are not immune to the confusion. Not only are the railroads confronted with the necessity of changing their designs to meet the varying requirements of different states, but they also find difficulty in compromising in their own individual disagreements. It is in an effort to effect some measure of order in a field now fraught with chaos that the specifications for steel highway bridges have been drawn by the Iron and Steel Structures committee. It is true that many of the provisions of this specification will be considered primarily "something to shoot at" and that eventual standardization throughout the country will involve a considerable degree of co-operative study with organizations of highway engineers, but the specifications submitted by the Iron and Steel Structures committee comprise a formidable document which should go a long way in the direction of definite progress.

A Standard Classification of Bridges

The work which the Committee on Iron and Steel Structures has been doing for the last two years in formulating rules and specifications for the classification of old bridges has undoubtedly been effectual in improving the practice of various roads in regard to this important feature of the bridge engineer's work. However, the greatest good will not be accomplished by the committee's work unless it has the result of effecting a general standardization of bridge classification on the various roads, through the adoption of a common unit of classification for bridge capacities and engine loadings. This should preferably be the Cooper classification because this already enjoys recognition among bridge engineers generally and has already gradually acquired a certain degree of understanding among operating officers. Indeed, no better reason can be given for the continued utilization of Cooper loadings as a standard for both the design of new bridges and the investigation of old structures than the fact of its present widespread application. The particular advantage of the use of a common standard by all railroads arises from the resulting simplicity in the handling of foreign equipment. With a common standard in vogue, a road desiring to detour trains over the lines of another road is required only to advise that its locomotives classify, say, as Cooper's E47 or E56 figures, which the road supplying the trackage can quickly check against its own records of bridge capacity. Indeed, the ultimate result of a general adoption of a standard classification would be the development of detour maps showing the bridge capacities for each link in the various routes and eventually these figures for bridge classification noted on the map would be deemed just as essential on a complete detour map as the position of wye tracks is considered today.

In Re: The Substitute Tie

Judging from the records prepared each year by the Committee on Ties, few fields of endeavor are strewn with more failures than that devoted to the discovery of a substitute for the wooden cross tie. Yet in spite of this disastrous record, the zeal of the inventor is undampened. Every year brings out a new crop of substitutes, each with its enthusiastic champion. But the goal seems as far away as ever. Because of this lack of progress after years of effort most railway officers have assumed a somewhat skeptical attitude toward the claims made by the promoters of substitute ties. It is this attitude on the part of practical railway men which was no doubt the underlying cause of the efforts made a year or two ago to effect retirement of the wooden tie through legislation disguised as a measure for forest conservation, but this project was given an effective death-blow through the agency of an able and convincing report prepared by the Committee on Ties at the instance of the American Railway Association. That the committee's conclusions were in no way founded on prejudice against the idea of a substitute was manifested by its continued willingness to investigate all efforts for the development of a substitute and this has borne fruit in the latest committee report in the form of an analysis of the requirements of a practical substitute. This will be of unquestioned value from two different angles; first, in pointing the way to rational design, and second in preventing the purposeless expenditure of time, energy and money in the exploitation of designs founded on the wrong premises. Unfortunately, many of the would-be inventors have no knowledge of railway requirements or familiarity with railway personnel or organization. Few of them ever learn of the committee's work until they have expended much effort to no purpose. This, however, is something for which the committee cannot be held responsible.

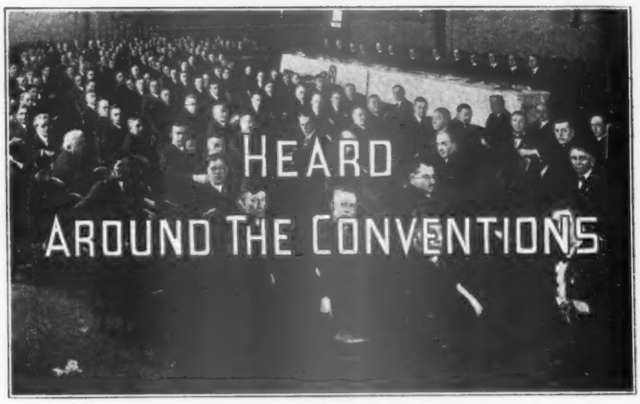
Concrete Slab Foundations

It is interesting to note that the reports of two of the committees, namely, the Committee on Ballast and the Committee on Roadway, each offered in its suggestions for work for the coming year the study of concrete slabs as a track support. An interesting sidelight on this suggestion is offered by the work now in progress in connection with the construction of the new Union station at Chicago. In addition to providing concrete slabs for the support of all of the tracks in the train shed with the aid of a special

construction in which the rails will rest on wooden blocks imbedded in concrete, all of the approach tracks within the limits of the station company's property, which are of standard ballasted construction, will be supported on a concrete blanket covering the roadbed. The depression of the tracks to a level but little above the Chicago river, has resulted in exceedingly soft roadbed conditions, the material being a blue clay that lends itself readily to pumping track when in a moistened condition. The extreme difficulty which would have been encountered in an attempt to maintain track under heavy traffic with no better support than that afforded by the blue clay led to the decision to install the concrete slab support. A considerable trackage carried on the slabs has now been in service under heavy traffic during the past two years, and effectively demonstrates the value of this construction under the conditions imposed. The suggestions offered by the committees cited above, together with comments heard from other quarters, indicate that there is considerable speculation on the opportunity for the extended application of the concrete slab as a track foundation. While it is not expected that installation of the concrete roadbed blanket could be justified over long stretches of track, even on heavy traffic lines, the suggestion is made that this construction should offer effective relief from soft track conditions in aggravated situations, particularly in soft cuts where the cost of maintenance in the absence of adequate track support is exceedingly high.

The Engineer and Sanitation

IT IS SELDOM, if ever, that the engineer is thought of prominently on railroads in connection with sanitation. It is the popular notion that this is the function of the medical department and even the engineers have shown an inclination to associate themselves with the idea of sanitation only remotely, usually considering it in the light merely of one of the incidents of their work (in a few cases where sanitary considerations arise) rather than as the objective. It is of interest, therefore, to note the attention given by the water service committee Tuesday to recent court decisions holding railroads liable for impure water supplies, as well as to the interest now being taken by Boards of Health in railway affairs. Aside from affording a striking indication of the growing responsibility of railroads for sanitation, not only in water service but in other directions affecting the health of employees or other persons under their charge, it is a forcible reminder of the place which the engineer has in sanitation and a timely suggestion of his obligation to the railroads in this respect. From the time the engineers built the famous aqueduct which freed Rome from a scourge of sickness which medical attention was powerless by itself to remove, the engineer has always been a principal bulwark of sanitation. As it becomes more and more important, with the trend of the times and multiplication of conditions promoting ill health, for railroads to concentrate upon sanitation for the sake of sanitation, it is well, therefore, that the engineer remember his abilities, his obligation and his opportunity in this direction and apply himself to serve in this connection as well as he has done in other connections. His present opportunity, of course, lies particularly in the field of water service and he can do much to promote sanitation in the regular routine of his work. But while studying water service with a view to promote sanitation, he should by no means overlook the possibilities to call attention to unsatisfactory conditions of his immediate department.



According to the records compiled by C. W. Kelly, secretary of the National Railway Appliances Association, the attendance at the Coliseum was 3,052 on Monday, 7,463 on Tuesday and 5,923 on Wednesday. Over 3,500 people visited the exhibit on Tuesday evening, the one evening when it was open.

* * *

The Toledo Terminal Railway has awarded a contract to the Ogle Construction Company for the erection of a 200 ton, two track, reinforced concrete coaling and sanding station at Toledo, Ohio. This station will have a hoisting capacity of 60 tons of coal an hour, and will have ground storage for 50 tons of wet sand and elevated storage for 15 tons of dry sand with stove sand dryers and pneumatic elevating equipment.

* * *

The Buffalo, Rochester & Pittsburgh has awarded a contract to the General Railway Signal Company for materials required for the installation of automatic train control on 15 miles of double track near Rochester, N. Y. The train control is of the intermittent induction type and is to be installed to operate as an automatic stop in connection with the existing automatic block signals. Provision has been made for the future addition of pairs of inductors to secure tapered speed control.

* * *

Frank R. Coates, president of the Toledo Railway & Light Company, and for many years an active member of the Arrangements Committee of the Engineering Association, visited the convention yesterday and renewed acquaintances. This is the first time that Mr. Coates has been able to attend the convention for five years. Mr. Coates is remembered as having had the courage to order the street cars of his company taken outside the state and to suspend service in that city during a controversy with the city several years ago.

* * *

Some misunderstanding seems to have arisen as to the final action of the Engineering Association in regard to Form 402-A, presented Tuesday in the report of the Committee on Rail, the impression being in some instances that the association adopted Form 402-A with the addition of two lines across it for brand and heat numbers. As a matter of fact, the motion to reconsider contained a rider to this effect, but as a motion of this nature under parliamentary practice could not contain such a provision, the action of the association became a straight reconsideration and on final vote Form 402-A was adopted as originally presented.

* * *

The entire sales organization, railway sales division of the National Carbon Company, Prest-O-Lite Company, Inc., were present at a dinner Sunday evening, March 11, in honor of J. M. Spangler, former manager of the

railroad department who has recently been promoted to the general sales division. A morocco bound Encyclopedia Britannica was presented to Mr. Spangler in appreciation of his work with the railway department. A. E. Pratt has succeeded Mr. Spangler as manager of the railroad sales department. J. R. Crawford, vice-president and general salesmanager of the Union Carbide Carbon Company, was a guest of honor at this dinner.

* * *

C. H. Tillett, signal engineer of the Grand Trunk at Montreal, Que., has been transferred to Toronto, Ont., effective March 1, as signal engineer of the central district of the Canadian National Lines, in accordance with the recent reorganization on the Grand Trunk. Mr. Tillett's new territory comprises the lines between Riviere du Loup and Monk, Que., and Portland, Me., on the east, and Chicago to Port Arthur, Ont., and Superior junction on the west. The lines included under Mr. Tillett's jurisdiction consist of portions of the Canadian National, Grand Trunk, Canadian Northern, Ontario lines, National Transcontinental and the Inter Colonial roads. T. A. Allen, chief signal inspector at Montreal, has also been transferred to Toronto.

* * *

Members of the Santa Fe Signal Supervisors' Committee consisting of officers of the signal department of the Santa Fe and former members of this organization, held their ninth annual dinner at the Illinois Athletic Club on March 13. Those present included T. S. Stevens, signal engineer, system; L. Brown and G. K. Thomas, assistant signal engineers, system; W. H. Rife, H. Hob son and E. Hanson, signal engineers; G. R. Cowherd, signal engineer, E. P. & S. W.; B. T. Anderson, assistant signal engineer, D. L. & W.; J. S. Hobson, W. H. Cadwallader, J. P. Coleman and H. A. Wallace of the Union Switch & Signal Company; C. W. Pendel of the Public Service Commission of Illinois, and P. B. Hyde, vice-president, General Battery & Supply Company.

* * *

As an indication of the extent to which scientific developments are being applied to railway operation the Illinois Central used the radio on Sunday evening, March 11, to locate trains which were overdue and from which no reports could be received during the storm on account of the interruption to telegraph and telephone service. Messages were broadcasted from stations K. Y. W. (Westinghouse Electric & Mfg. Company, Chicago) and W. D. A. P. (Chicago Board of Trade, Drake Hotel, Chicago), requesting listeners to communicate with dispatchers in their district and report information regarding trains on their divisions. Among other trains the Hawkeye Limited, en route from Omaha to Chicago and stormbound west of Freeport, Ill., for 10 hours, was located in this way.

* * *

At least forty members of the American Railway Engineering Association are expected to make the trip of inspection of the Structural Material Research Laboratory and the Underwriters' Laboratories on Friday morning, March 16. The party will assemble at the Congress hotel at 9 a. m. and will proceed by taxicabs to Lewis Institute. Professor D. A. Abrams and his staff will make tests and demonstrations showing the results of the exhaustive investigations of concrete which they have carried on for the past nine years. Lunch will be served at Lewis Institute at noon, after which the party will proceed to the Underwriters' Laboratories, where elaborate fire tests of building materials in full size wall sections will be made. A concrete block wall which will be placed in the furnace at a temperature of around 2,000 deg. F. will be removed for the inspection of the guests at 2:30 p. m., after having been heated for three hours. Reservations for the trip can be made in the Florentine room of the Congress hotel at any time today.

* * *

At the suggestion of Colonel W. G. Arn, assistant chief engineer, Chicago Terminal Improvements, Illinois Central, Chicago, the reserve army which is being formed under the National Defense Act of 1920 to supplement the regular army and the National Guard in case of war, will contain a number of railroad battalions which will be assigned as units to various railway systems. The War Department has authorized the organization of 36 railway engineer battalions, each consisting of headquarters, platoon operating, maintenance of equipment and maintenance of way companies to be allocated to and designated by the names of principal railway systems. These battalions are to include 18 officers and 560 enlisted men, each to be organized from among officers and employees of railways as part of six field army reserves now being formed on a skeleton basis for service in event of war or other national emergency. The new plan supercedes the one under which a few railway battalions had been formed or partly organized in connection with the corps area organization. The officers are to be railway employees with military experience and the men will be preferably those with some experience. It is the plan for officers and employees from all points on any one railway system to be assigned to the unit formed on that system. This unit will be assigned to the army corps headquarters in which the railway is located.

A. R. E. A. Program

The following is the program for the convention of the American Railway Engineering Association today:

Uniform General Contract Forms	Bulletin 253
Electricity	Bulletin 254
Buildings	Bulletin 254
Wooden Bridges and Trestles	Bulletin 254
Records and Accounts	Bulletin 254
Yards and Terminals	Bulletin 255
Wood Preservation	Bulletin 255

New Business.
Discussion on Revision of Classification of Accounts.
Installation of Officers.
Adjournment.

Signal Convention Program

The following is the program for the concluding session of the convention of the Signal section of the American Railway Association:

Committee IV. D.C. Automatic Block Signaling.
Committee XVIII. Direct Current Track Circuits.
Committee XVII. Pole Lines.
Regulation.
Committee VII. Direct Current Relays.
New Business, election and installation of officers.
Adjournment.

Wood Preservers Will Go to Madison

Approximately 50 engineers interested in the preservation of timber are planning to visit the Forest Products Laboratory at Madison, Wis., on Friday, where opportunity will be afforded to inspect the laboratory and the work being done there and to discuss the problems now confronting the wood-preserving industry, including the shortage of crude oil and the possibility of developing substitutes therefor. The party will go to Madison on sleepers attached to a train leaving Chicago late Thursday night. Reservations should be made direct with the railway. Arrangements have been made for those who anticipate making this trip to gather at dinner at the Builders' Club in the Chamber of Commerce building at six o'clock Thursday evening.

The New Mail Terminal Building Erected as a Part of the Chicago Union Station Project

The Engineering Association Has a Busy Day

Wednesday's Sessions Include Presentation of Eight Reports. Memorial Meeting for Deceased Members

THE CONVENTION of the American Railway Engineering Association was called to order at 9 o'clock yesterday morning by President Campbell, and the consideration of reports of standing committees was undertaken at once. The attendance through the day exceeded that of Tuesday, the room being practically filled at all times. A special feature of the program was the setting aside of an hour prior to the close of the morning session in memory of those officers and members of the association who have died during the year.

Reports were made by committees on Ties, Economies of Railway Location, Economics of Railway Labor, Stresses in Railroad Track, Track, Economics of Railway Operation, Rules and Organization and Roadway.

Report of the Committee on Ties

For many years the report of the Committee on Ties has included, as one of its regular features, a progress report on the results being obtained with substitute ties. At intervals summaries have been prepared to condense the matter presented over a considerable number of years into a compact statement. Further progress was made in correlating or condensing the information collected in studying the service records of substitute ties, in the form of a statement of the fundamentals to be considered in the design of such ties. The committee also presented a report on the care of ties after distribution, a phase in the use of ties which has an important bearing on the service life to be obtained from them. A report was also presented on the test sections for studying the service life of cross ties. Investigation by the committee disclosed a variety of practices in this regard and no effort was made to formulate any standard method. However, in its conclusions the committee emphasized the importance of continued study of service life of ties through the installation of test sections. Among its recommendations for future work is a study of foreign ties used in this country. W. A. Clark has been chairman of the committee for two years, was previously vice-chairman for two years, and is completing his tenth year on this committee.

W. A. Clark
Chairman

THE ACTION RECOMMENDED by the committee was as follows:

1. That the material in its Appendix A, namely, the annual report on substitute ties in service, be received as information.

2. That the fundamentals to be considered in designs of substitute ties, found in Appendix B, be approved for publication in the Manual.

3. That the conclusions and recommendations in Appendix C, relating to the care of ties, be approved for publication in the Manual.

4. That the conclusions contained in Appendix D, relative to test sections, be approved for publication in the Manual.

Committee: W. A. Clark (D. & I. R.), Chairman; W. J. Burton (M. P.), Vice-Chairman; M. S. Blaiklock (C. N. R.), R. S. Belcher (A. T. & S. F.), F. Boardman (N. Y. C.), H. A. Cassil (P. M.), S. B. Clement (T. & N. O.), E. L. Crugar (I. C.),

J. F. Deimling (M. C.), W. T. Evans (C. & A.), S. B. Fisher (M. K. & T.), John Foley (Penna.), O. H. Frick (C. M. & St. P.), G. F. Hand (N. Y. N. H. & H.), H. C. Hayes (I. C.), F. R. Layng (B. & L. E.), R. M. Leeds (L. & N.), A. F. Maischaider (C. C. C. & St. L.), A. J. Neafie (D. L. & W.), G. P. Palmer (B. & O. C. T.), L. J. Riegler (Penna.), S. E. Shoup (K. C. S.), J. W. Williams (W. P.), R. C. Young (L. S. & I.).

Appendix B—Substitute Ties

Based upon past experience and upon the fundamentals in Exhibit A, the following ties, in the opinion of the committee, warrant further trial: Atwood, steel and concrete; Bates, reinforced concrete; Carnegie, steel; Metal Tie Company, steel and wood; Railway Tie Company, steel and wood; Riegler, steel and concrete; Snyder, new, steel.

In making the above selection, the committee has had in mind four different classes of service, as follows: Heavy service high speed insulated tracks; heavy service non-insulated tracks; branch lines; and side tracks. It believes that some substitute ties not suitable for high speed main track may be found economical in side tracks, thereby conserving the timber supply for main track use. Also that some, on account of high first cost, can be used economically only in heavy service tracks. The committee again calls attention to the desirability of extensive tests of substitute ties, notwithstanding the improbability of immediate general use.

Exhibit A—Fundamentals to Be Considered in Designs of Substitute Ties

1. *Safety.*—The substitute must be designed so as to have sufficient strength to prevent failure of the tie or its fastenings, and sufficient bearing surface on the ballast, and with the rail to properly support the loads imposed, and provide against undue deflection in the rail.

2. *Performance.*—Track will not remain permanently to gage, surface and line under the loads imposed upon it, and labor operations, more or less frequent, will always be necessary to restore it. Therefore, the tie should be designed as far as practicable to resist the forces tending to disturb these conditions and to readily permit restoration.

Fastenings.—The fastenings must be of sufficient strength to maintain gage and so designed that without taking the tie from the track and without change to the holes, or fixed bolts or projections in the tie, a reasonable change of width or thickness of the base of rail, or variation of gage, may be made. The fastenings should be such as to offer as little obstruction to derailed wheels as possible. They should permit shimming where necessary, the change of defective rail, or the renewal of rails with ease, and should be replaceable if broken or defective, without disturbing the tie.

Gage.—If the design provides one support under each rail, united by a transverse member to hold gage, the transverse member must be of sufficient strength to maintain gage and plane, and of such design as to withstand a reasonable amount of the damage incident to derailment. The bearing of the rail on the tie must in all cases be of sufficient area to prevent widening of gage by canting.

Line.—The tie should be of such shape that it will not only resist the tendency of track to get out of line, but also permit the track to be thrown back to line. Projections on the base of the tie that project into the ballast make it necessary to lift the track out of surface before relining, and are therefore objectionable. Ties clamped in pairs which enclose a considerable amount of ballast between their several parts, to such extent that the ballast must be removed before the track is lined, add a material burden to the labor necessary to line track.

Surface.—The tie should have sufficient length and breadth to provide a bearing surface per rail length of track at least equal to that obtained with wood ties, for the same class of track, without reducing the space between the ties to such an extent as to make tamping difficult. It should have sufficient stiffness as a beam to develop the full bearing area on the roadbed.

The base of the tie must be shaped that the ballast can be readily and effectively tamped under the tie and also not cut into or disturb the tamped bed.

Insulation.—When insulation is desired, the design should permit of insulation without a material change in the tie proper. The fastenings must be so designed that the insulation material will not be subjected to abrasion or to great stress other than compression.

3. *Economy.*—The annual cost per unit of length of track for renewals and track maintenance should compare favorably with wood ties. Economy in renewals depends upon first cost and durability. Economy in maintenance will depend upon how closely the requirements heretofore specified are met.

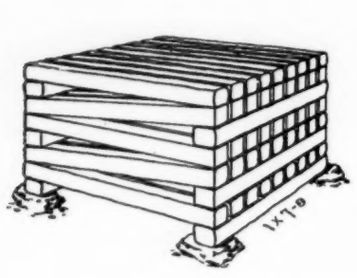


Fig. 1—Round or Rectangular Ties

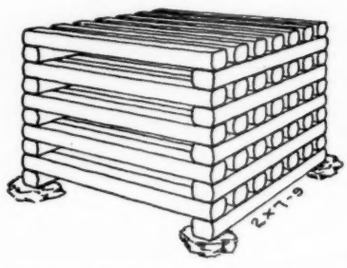


Fig. 2—Round Ties

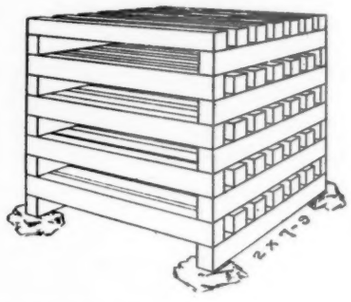


Fig. 3—Rectangular Ties

Open Stacks for Untreated Ties or Zinc Ties Where They Will Not Dry Too Rapidly

Appendix C—Care of Ties After Distribution

The results obtainable from ties of the character procurable under the standard specifications of the A.R.E.A. depend in no small measure on the care given to the ties after their delivery to the railroad which has inspected and purchased them. Maximum results from good ties cannot be expected if they are abused while stored.

To obtain information regarding present practice in the care of ties, a questionnaire was sent to the members of the association, and the replies are detailed in the accompanying tabulation. They show variations which indicate that the latest knowledge of the subject is not everywhere applied, and make evident the need for standard regulations which can be set forth as recommended practice for inclusion in the Manual.

Storing.—Ties should be stacked on ground bare of debris or vegetation for at least two feet around each stack and clear of vegetation over six inches high within 10 ft. of any stack and sufficiently well-drained so that water will not stand under the stacks or in their immediate vicinity. Decaying wood debris should be thoroughly removed.

Manner.—Untreated and zinc treated ties should be stacked so as to obtain free circulation of air, minimum contact, and where storage space is limited maximum economy of space consistent with economical handling, for which purposes the best stacks are one or two by seven to nine, depending on the widths of the ties (Figs. 1, 2 and 3), except when or where the ties would be subject to splitting from too rapid drying, in which seasons or localities semi-solid stacks (7-9 by 7-9), with the end ties on their sides (Fig. 4) should be employed. Stacks should not be over 20 layers high, and the bottom layers should be kept at least six inches above the ground. Decayed ties should not be used as sills, nor untreated ties if treated ties or non-decaying materials are available. Alleys at least three feet wide should be maintained between rows of stacks.

Creosoted ties should be stacked as compactly as practicable (Figs. 5 and 6) and should be covered with cinders or dirt wherever exposed to falling sparks.

Stored ties of any kind should not be accumulated in groups of stacks without adequate spacing between the groups to permit fire control nor without the maintenance of bared or plowed ground at least three feet wide around the storage yard wherever fire from adjacent areas may spread.

S-Ironing.—Hardware ties received without anti-splitting devices should have S-irons effectively placed in each end as they are stacked for storage. Any kind of tie which starts to split in track should be S-ironed promptly.

Seasoning.—After treatment zinc treated ties and fir ties which have been boiled should be seasoned at least two months before insertion in track.

Choosing.—Where choice has to be made between distributed ties of unequal age, but equal suitability for given trackage, the oldest ties should be used first, provided it is not practicable to determine and use the least durable tie first and to see that no tie is held in storage longer than one-fifth of its estimated life in track.

Adzing.—Ties shall be adzed only when necessary to obtain a full bearing under rail or plate, and as far as practicable all adzing of uneven bearing surfaces should be done by machine rather than by hand.

Handling.—Ties should be moved with tongs so as to reduce the damage incident to handling them; picks, mauls, sledges, and spiking hammers should not be used in moving ties or placing them in position beneath rails.

Installing.—Untreated ties should be placed in track with the wide surface having the most heartwood down; treated ties should be placed in track with the wide surface nearest the pith down, or if the pith is not present in the tie, with the widest surface down.

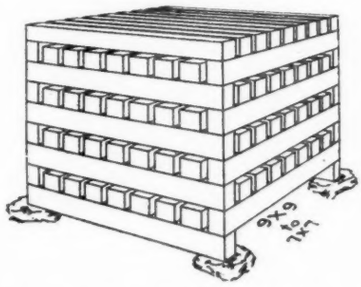
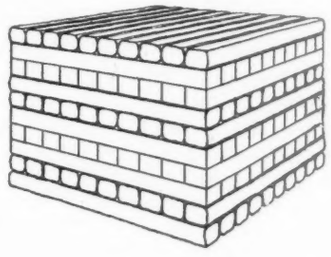


Fig. 4—Semi-Solid Stack for Zinc Ties Where Subject to Rapid Drying



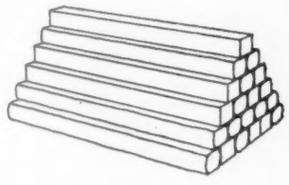


Fig. 5 and Fig. 6—Solid Stacks for Creosoted Ties

Appendix D—Installing and Keeping Records of Test Sections

Summary.—The committee found many variations of test sections in use today, and realizing the importance of continuing these tests to a conclusion, since they will serve the purpose for which installed, believes it is unwise to recommend a specific type or length of section to be used. The forms in use also vary so much that it is thought best to leave it to the individual road to use its own form until experience with the many forms employed demonstrates the most desirable. However, to make comparisons feasible and thus enhance the value of all test tracks, it is suggested that, wherever practicable, data on existing test sections conform as nearly as possible to that outlined in the following recommendations regarding future installations of test sections.

Conclusions

The committee recommended:

1. The continuance of all tests now under way.

2. The installation of either "Renewal" or "Out-of-Face" test sections, or both.

3. Each "Renewal" test section should be not less than one mile and not more than one section foreman's territory in length.

4. Each "Out-of-Face" test section should contain not less than 100 ties of each kind under test, and at least two different varieties, including the standard test tie, should be used in each section for comparison.

The total length of each section should be so limited that the alinement, ballast, drainage, other track material, rail and traffic will be as nearly as possible the same for each tie.

The possibility of establishing long "Out-of-Face" test sections under predetermined conditions, when constructing new main tracks or on extensions of road or second track work, should also be considered.

5. Records should be kept to show for each test section of either type its location, kind and depth of ballast, alinement, rail, other track material, size of tie, spacing of ties, kinds of wood, details of preservative treatment, date installed, date removed, cause of removal, such as decay, mechanical wear or wreck.

On "Renewal" type of sections, a record of ties in track when test section is started should not be compiled unless the date installed and kinds of ties are known.

On the "Out-of-Face" type of sections additional records should be kept to show the condition of sub-grade, drainage, fill or cut, annual gross tonnage, freight plus passenger, and maximum scheduled speed of each, mean temperature of the locality for January and July and annual rain fall. All ties on this type of section should be installed within 30 days and records kept of only the ties originally installed, until all have been removed and test completed.

6. Where the "Out-of-Face" type of test section is used, a certain kind of tie, preferably white oak, Grade 3 (6 in. by 8 in.), Class U, untreated, 8 ft. long, should be used as the standard test tie, as recommended and adopted last year.

7. Test sections should be so selected as to be representative of the territory where installed, and should be located where there are no switches and no likelihood of disturbance by new construction or abnormal rail renewals.

8. Test sections should be marked by suitable monuments at each end.

9. Regular inspections should be made of test sections at least once each year by someone qualified to make accurate observations and keep good records, and so arranged that the tests will be continuous and not affected by changes in the personnel.

10. Ties should not be removed from test sections except in emergencies, without the approval of the official responsible for the maintenance of the tests, and should not be destroyed until inspected by him or his representative.

Discussion

(The report of the committee was presented by W. A. Clark, chairman. L. J. Riegler, chairman of sub-committee, outlined the report on substitute ties and a *motion to approve the matter in Exhibit A, Appendix B, for insertion in the Manual was carried.* The report of the sub-committee on care of ties after distribution was presented by John Foley, chairman of the sub-committee, and the recommendation contained in Appendix C, relating to care of ties, was approved for publication in the Manual.)

The report of the sub-committee on Installing and Keeping Records of Test Sections of Track with reference to service life of ties was presented by its chairman, G. P. Palmer, and the conclusions contained in Appendix D, relative to test sections, were approved for publication in the Manual.

(The committee was then excused with the thanks of the association.)

Report on Stresses in Track

The work of the Special Committee on Stresses in Track is the third progress report of this committee, carrying the study of stresses much farther and in more complete detail than the previous reports. The tests were conducted on both tangent and curved track on four railroads, using 13 locomotives of eight different types, in co-operation with a special committee of the American Society of Civil Engineers. In previous tests four stremmatographs had been the largest number used, in contrast to the use of eight in the tests described in the third progress report. Measurements were taken on both rails. Approximately 470,000 microscopic readings of strains were made. The large amount of data which is given covers stresses resulting from the effects of speed, of counterbalance, of combined speed and counterbalance, lateral bending movement, vertical bending stresses, distortion, loads, etc. With the exception of the results with the Light Santa Fe type locomotive, the tests on straight tracks, indicated no abnormal stresses in rail under any of the wheels at any speed. However, much of the information throws new light on locomotive design. Professor Arthur N. Talbot, University of Illinois, has been chairman of this special committee since its organization as well as the committee of the A. S. C. E.

Arthur N. Talbot
Chairman

THE FIRST PROGRESS REPORT on this subject was published in Volume 19 of the Proceedings of the American Railway Engineering Association (1918). In this report a method of analysis for determining the moments and stresses in the rail by considering the track as an elastic structure was presented, the instruments and methods of testing were described, the depression of the track and the rail profile under load were given, and the stresses developed in the rail under a variety of loads were recorded. The report relates principally to stresses in rail and to the general elastic conditions of the track.

The second progress report of the committee was published in Volume 21 of the Proceedings and in Bulletin 224. This report gives the results of tests on two railroads with several types of locomotives to determine the stresses in rail in relation to speed and counterbalance effect. It records the results of tests on two railroads to determine the depression of track and the flexure of ties and their action under load for a variety of conditions found in track. Tests to find the manner and the principles involved in the transmission of pressure from one or more ties downward and laterally through ballast material were reported and an analytical consideration of the transmission of pressure given.

The third progress report, an abstract of which appeared on page 229 of the January 20 issue of the *Railway Age*, includes tests on straight track and curved track. The tests on straight track considered the effect of counterbalance, the effect of speed and the combined effect of speed and counterbalance, and the lateral bending moments and stresses in the rail. For the curved track there are taken up the general action of curved track as the locomotive traverses the curve, the magnitude of the vertical bending stresses in the rail and the corresponding vertical loads producing them as contrasted with the normal loads, the lateral bending moments and stresses under the several wheels, the distortion of the alignment of the curves, and the general effect of speed, degree of curve and superelevation. The tests were conducted on the Illinois Central, the Delaware, Lackawanna & Western, the Atchison, Topeka & Santa Fe, and the Southern Pacific. Eight distinct types of locomotives were used; in several types there were variations in the design of the locomotives of the different railroads and the number of locomotives used in the tests was 13. The report is presented under the heads of Tests on Straight Track and Tests on Curved Track. The committee is continuing work on the subject assigned to it.

Committee: Arthur N. Talbot (Univ. of Ill.), chairman; W. M. Dawley (Erie), vice-chairman; G. H. Bremner (C. B. & Q.), John Brunner (Ill. Steel), W. J. Burton (M. P.), Charles S. Churchill (N. & W.), W. C. Cushing (Penna.), P. H. Dudley (N. Y. C.), H. E. Hale (Pres. Confr. Com.), Robert W. Hunt (Cons. Engr.), J. B. Jenkins (B. & O.), George W. Kittredge (N. Y. C.), Paul M. LaBach (C. R. I. & P.), C. G. E. Larsson (Am. Bridge Co.), G. J. Ray (D. L. & W.), Albert F. Reichmann (Am. Bridge Co.), H. R. Safford (C. B. & Q.), Earl Stimson (B. & O.), F. E. Turneaure (U. of W.), J. E. Willoughby (A. C. L.).

Discussion

A. N. Talbot (chairman), reviewed the committee's report and read abstracts from it:

With the exception of the light prairie type and the

light Santa Fe type, it will be seen that the general increase in stress in rail under the drivers due to speed alone in changing from five miles per hour to the highest speed used in the tests ranges from 15 to 27 per cent, which may be called a moderate and allowable speed effect. With the same exceptions, the maximum speed effect under any one driver ranges from 24 to 30 per cent.

As a bearing upon the effect of trucks, which may appear to be the same as that of tenders, the results for the stresses under the tender wheels may be understood by reference to the following comment: "The great variation in the effect of speed under the wheels of the tenders of the various locomotives agree with the results noted in the second progress report of the committee. It seems that there must necessarily be considerable difference in the design and construction of tenders, or in their maintenance."

With regard to the stresses at the two edges at the base of rails, representing the lateral bending in the rails, we all think of the matter of centrifugal force or superelevation. In general, the average for all the wheels on the outer rail and all the wheels on the inner rail gives a value that agrees fairly closely with our theoretical value of the difference between them according to the speed used. However, there is a great difference in the stresses in the individual wheels in one place and another.

It will be recognized that something must turn the locomotive in going around a curve, and this is done by the flanges of the leading wheels; sometimes by the leading truck, and if there is only a single truck, also by the first driver, the flange bearing against the outer rail.

Now, there will be a side slipping of these wheels on the rail. Every wheel except, say, one will have a lateral slip. Those in front of the point of rotation will slip inwardly on the curve. Those to the rear of the frame will slip outwardly. That means there is not only this pressure against the rail at the leading wheels, but there is also a pressure outwardly on the curve at one or more of the drivers, and that all of these drivers produce lateral pressure on the rail. This lateral pressure so produced may become very great. It is concentrated on the inner rail at low speeds, ordinarily commencing at about the rear driver, and at higher speeds that is relieved, and the pressure against the outer rail increased. That causes bending stresses in the rails, but, what is more important, and perhaps what has not been thought of before, is that somehow this lateral pressure results in a higher bearing pressure of some wheels.

The method of analysis involved in this is to consider two actions together there, one the vertical bending action (and the mean stress on the base of the rail is taken as representative of that), and the other the lateral stress. If now the lead wheel must apply very high pressure on the rail at low speeds, it is not apparent in large amounts for higher speeds up to a point, say, about two-thirds of the speed of superelevation, where it is not very much, and beyond the speed of superelevation the loads are divided among the different wheels in the way we should expect them to be. But somehow or other the position of the flange, or the action of the equalizing levers, or the increased stiffness of the springs as the load comes on, makes this division of load very much different than what it is normally expected to be.

These lateral bending stresses, which you will see are quite large, have to be added to the vertical bending stress in order to get the maximum stress.

I wish to call your attention also to the diagrams of bending moment in the rails in the report, which show at the different speeds what the lateral bending moment is, at and between the different wheels. Another diagram shows what the action is upon the track, first, one wheel pushing it outwardly and another bending it inwardly, while at points in between the action is opposite. It is evident that the track is subjected to very great stresses in the different directions.

B. R. Leffler (N. Y. C.): The committee reports that it finds the lateral bending moment as high as 14 per cent of the vertical bending moments. This is important in considering a distribution of the pressure between the base of the rail and the top of the tie. This lateral force, combined with the vertical wheel load, must give a diagonal resultant force through the rail, and I think that therein lies the reason why on a straight piece of track the outer edge of the rail cuts into the tie.

Mr. Talbot: Sometimes the greater stress is found on the inner edge. It may be partly a condition of the track, but for the same spot it seems to be a difference in the condition of the wheel and the way the locomotives strike the track.

Now, reference was made here to this ratio between the stress at the outside edge of the rail and the mean stress in the rail, which measure and indicate the lateral bending. So far as I can see, it is proper to use this as an indication of the lateral pressure that Mr. Leffler refers to.

In all of these tests the average of all the wheels, and all the observations, made this ratio 106. It would vary somewhat between the range of 106 and 110. That is to say, the average between the wheel stresses on the outside is six to ten per cent more than the mean stress at the middle. Although generally this pressure is outward, so that the tendency of the rail is to tip out with upright rails, yet there is the other tendency and there is a great variation. I think it does bring out the lesson that we ought to have motive power kept up and our rolling stock kept up in better shape.

O. E. Selby (C. C. C. & St. L.): It occurs to me there are some conclusions that might be drawn from these results with reference to the question of canting the rail. If it is a fact that there is a lateral component of 14 per cent on the rail, that means a departure from the vertical of 1 and 7 for the resultant of the vertical and lateral force. Of course, I am not advocating canting the rail 1 and 7, or anything like that, but it occurs to me that the purpose would be served of getting the stresses in the base of the rail equal and getting the base of the rail normal to the resultant stress by canting the rail some amount less than 1 and 7.

Hunter McDonald (N. C. & St. L.): I have been very much interested in the remarks of Mr. Leffler about lateral pressure in rails. I think when engines run at very high speed, and especially when the lateral play in the hubs has been permitted to go to the limits that are permitted by the Interstate Commerce regulations, nosing is more and more observable, and the effects on the track are very much greater.

It has occurred to me that perhaps some lessons of value might be obtained by a study somewhat along the lines of those that were instituted some years ago by Mr. Gibbs of the Pennsylvania, where he was endeavoring to determine the relative lateral effect of electric locomotives with their centers of gravity low and high. I have not the exact data at hand, but it has appeared to me that a study along those lines would be illuminating, and, furthermore, if it would be possible to carry the study of the lateral forces still further to the point of actually measuring the resisting effects of various kinds of ballast, which are dependent upon the bottom and side friction.

Mr. Talbot: In answer to Mr. Selby, if we begin canting the rail we should expect that that would put us

in difficulties in other ways, for then the inside edge of the base of the rail would begin to have the higher stress. Before we could determine just what amount of canting should be put in, we would need to know what the condition of our rolling stock is going to be. It is a much more complicated question, I think, than we have any idea of.

(The committee was excused.)

Report on Economics of Railway Location

The Committee on Economics of Railway Location is concerned more largely with problems involving the application of scientific analysis than almost any other of the standing committees of the association, and its membership includes a larger proportion of men who are not directly in the employ of the railways. A considerable number of them are in private consulting practice, and several of these are authors of well known books on railway location. The report of the committee for the present year was confined to a revision of certain portions of the Manual, but considerable progress is reported on some of the other subjects that were assigned to it.

Edward C. Schmidt
Chairman

Edward C. Schmidt, the new chairman, has served as a member of the committee for the last 10 years and is peculiarly qualified for the work because of his knowledge of both the mechanical and civil engineering phases of the problems with which the committee must deal. He has been professor of railway engineering of the University of Illinois since September, 1921, having previously served for 11 years on the faculty of that institution. During the war he served in the ordnance department of the army and later on the staff of the Fuel Administration. He has also been employed in various capacities by concerns in the railway appliance field.

THE COMMITTEE'S REPORT was limited to the revision of the Manual. The proposed changes are set forth in Appendix A, with the recommendation that these revisions be incorporated in the Manual.

Committee: Edward C. Schmidt (U. of Ill.), chairman; Willard Beahan (N. Y. C.), vice-chairman; R. N. Begien (B. & O.), John C. Beye (I. C. C.), H. R. Carpenter (M. P.), A. S. Cutler (U. of M.), A. S. Going (C. N. R.), Fred Lavis (Cons. Engr.), E. H. McHenry (Cons. Engr.), E. W. Metcalf (M. K. & T.), H. C. Searls (M. P.), A. K. Shurtleff (A. R. E. A.), C. W. Stark (Board of Econ. & Engr.), John G. Sullivan (Cons. Engr.), A. M. VanAuken, R. H. Washburn (C. & A.), Walter Loring Webb (Cons. Engr), M. A. Zook (Cons. Engr.).

Appendix A—Revision of the Manual

The committee recommended the following revisions:

1. Definition 3 on page 800 now reads:

(3) The most general formula for the economic value of a location is:

$$\frac{R - E}{C} = p, \text{ where}$$

R = Annual revenue (receipts from operation).
E = Annual expense of operation, including depreciation and taxes.
C = Capital invested (cost of construction).
p = Percentage of profit on investment.

We recommend that the last line be changed to read:

p = Percentage of *income* on investment.

2. We recommend the following revisions in Section (12), on page 803:

Present Form	*Proposed Form*
	COMPARISON OF DIFFERENT LINES
COMPARISON OF ALTERNATE LOCATIONS	
(12) The location of terminal points, ruling gradient, and pusher gradients having been decided upon, the effect of the minor details of location, namely, distance, curvature, and rise and fall, upon operating expenses may be determined approximately in the following manner:	(12) A line may be a reconnaissance, a preliminary, a projection, a location, or a railroad (constructed line). Comparisons may be made between any two or more lines of the same or different kind. The location of terminal points, ruling gradient, and pusher gradients having been decided upon, the effect of distance, curvature, rice and fall upon operating expenses may be determined in the following manner:
Alternative locations may be compared by distance, curvature and line resistance. Distance is the length of the line measured along the center line of location. Curvature is the number of degrees of central angle subtended by the center line of track; it may be divided into sharp curvature, necessitating a reduction of speed for trains, and ordinary curvature, which will again be subdivided into that increasing line resistance in both directions and that increasing line resistance in one direction only. Line resistance is the sum of the rolling resistance (or friction resistance), plus the resistance of gravity overcoming difference in elevation on ascending grades, plus the resistance due to curvature, minus the energy of gravity on trains on descending grades, from which has been subtracted the loss of energy (or velocity head) due to the application of brakes.	Different lines may be compared by distance, curvature and line resistance. Distance is the length of the line. Curvature is the number of degrees of central angle subtended by the line; it may be divided into sharp curvature, necessitating a reduction of speed, and flat curvature, which can be divided into curvature increasing line resistance in both directions and curvature increasing line resistance in one direction only. Line resistance is the sum of the rolling resistance (frictional resistance) plus the resistance of gravity overcoming difference in elevation in ascending grades, plus the resistance due to curvature, minus the energy of gravity on trains on descending grades, from which has been subtracted the loss of energy (velocity head) due to application of brakes.
In comparing different locations the resistance under average conditions should be used.	In comparing different lines, the resistance under average conditions should be used.

3. Change the first sentence of Section (14) on page 804 as follows:

Present Form	*Proposed Form*
MINOR DETAILS	RELATIVE VALUE OF DISTANCE, CURVATURE, RISE AND FALL
(14) To determine the relative value of the minor details of location under consideration (curvature, distance, rise and fall), it is first necessary	(14) To determine the relative value of distance, curvature, rise and fall, it is necessary to decide upon methods of studying the effects of these

to decide upon a method of studying the effects of these factors on the cost of operation.

4. Change Section (16) on page 805 as follows:

Present Form	*Proposed Form*
TIME	TIME
(16) Time will not as a general thing constitute an important factor in the consideration of the minor details of location, but if the difference in time required to operate over alternative locations is of sufficient importance to affect the amount of equipment to operate the line, and consequently the annual charge for same, or the earnings of the line, or the trainmen's wages through overtime, then this item must be taken into consideration.	(16) As saving of time is an economic operation, this item should be taken into consideration and given proper value as the conditions may warrant.

factors on the cost of maintenance and operation.

5. We recommend the insertion in Table 2 on page 808 of the following values to fill in the gap now left between cylinder diameters of 23 and 28 inches.

Diameter of Cylinder in Inches	Weight of Steam per Foot of Stroke for Various Gage Pressures						
	160 lb.	170 lb.	180 lb.	190 lb.	200 lb.	210 lb.	220 lb.
24	1.218	1.283	1.348	1.416	1.482	1.555	1.620
25	1.322	1.392	1.462	1.536	1.608	1.688	1.758
26	1.430	1.506	1.582	1.661	1.739	1.825	1.901
27	1.542	1.624	1.706	1.792	1.875	1.968	2.050

6. We recommend that throughout the section on Power on pages 805 to 813 the word "power" be changed either to *"force"* or *"tractive force."*

Discussion

(The report of the committee was outlined by Edward C. Schmidt, chairman. The report of the subcommittee on revision of the Manual was submitted by its chairman, Willard Beahan, and accepted without change. The committee was then excused with the thanks of the association.)

Memorial Service for Deceased Members

THE LAST HOUR of the morning session yesterday was devoted to a memorial to the members of the association who died during the past year and in particular to A. S. Baldwin, Wm. McNab and C. E. Lindsay, who have served the association in official capacities. Space does not permit more than a brief abstract of the touching and inspiring comments which the various members addressed to the solemn occasion.

The President: We are pausing in our proceedings at this time to pay our tribute to three noble men who were members of this Association. In making this tribute to them, we shall not forget the other 12 members of the Association who have also passed to the great beyond during the past year. It is fitting, however, that we should mention especially Archibald Stuart Baldwin, Charles Elder Lindsay and William McNab, Mr. Baldwin having died last June; Mr. Lindsay, February 17; and William McNab, on February 27. These men were pioneers and leaders in this association. They were men with whom all of you became well acquainted.

H. R. Safford (C. B. & Q.): It was my personal privilege to have close social and professional association and contact with all three of these men. It was also my personal privilege to have business contact with Mr. Baldwin and Mr. McNab, and it was my privilege to serve on a board of this body with Mr. Lindsay. I can look back to memories of those associations with one very definite, outstanding result. These men were all faithful and loyal to our association. I doubt very much if they were connected with any organization that was closer to their hearts than the American Railway Engineering Association. I know that was particularly true of Mr. Baldwin. He helped to form its basic characteristics. He helped it through its beginning and on to success. He was particularly interested in seeing that the young men came into this body, and they are, in my opinion, perhaps the greatest reason for its success. He gave his service and the memory of that service is an obligation that we can only attempt to repay in part by doing our little bit in trying to perpetuate his principles and characteristics in this body.

C. S. Churchill (N. & W.): In speaking of Mr. Baldwin, I can best refer to the closing paragraph of his address when he closed his work as president of the association. I think that that is one of the most pathetic statements in the records of the association. He foresaw the conditions that have existed in this country since the close of the great war.

Mr. McNab, like Mr. Baldwin, was a personal friend of mine. They had both been in my home. They were, as you know, always ready to do the greatest amount of work possible along the lines assigned to them. Mr. McNab perhaps is described best as being the wheel horse of his society in whatever work he undertook. All the way through his work, he was one who kept up the social side, helping this association in its annual conventions in every way possible.

Mr. Lindsay, as you know, was very careful in watching the proceedings of this association. Everything he did was to its advantage. I can not think of any three men who did such work as these three. We shall all miss them.

Hunter McDonald (N. C. & St. L.): I don't know of any three men regarding whom I could speak with more feeling of appreciation than I can of these three. I have always been drawn to Mr. Baldwin, whom I had known since he began his railroad career. He always struck me as being a man who was very tenacious in his convictions, but when convinced that he was wrong, was always willing to concede it.

With regard to Mr. McNab, I, of course, cherish a very fond remembrance of him. He was a very warm friend and every one with whom he ever came in contact regarded him as a friend.

At Washington for about six weeks, I often had lunch with Mr. Lindsay, who was then serving on one of the Boards. I was convinced from my conversations with him that he was devoting a very conscientious life in an endeavor to hold up the railroad side of a situation in which he was very largely in the minority. I believe that Mr. Lindsay's life was shortened to some extent by his tremendous efforts and I feel that the railroad men of this country owe him a great debt of gratitude for the work that he did on that committee.

G. A. Mountain (Canadian Railway Commission): Probably, I knew Mr. McNab longer than even the Grand Trunk officers in this room. I was associated with him in the middle eighties in connection with the formation of the Canadian Society of Civil Engineers in which he took a very active part. I might say in con-

nection with this association that I don't know anything that can describe his ability better than the article published in the *Railway Age* of yesterday in which he was alluded to as "Canada's representative in the A. R. E. A."

E. H. Lee (C. & W. I.): One of the things that has always impressed me as an unusual characteristic in Mr. Baldwin was his courage. I doubt very much whether many of his friends knew the great physical handicap under which he did his work. His friends have now come to believe that for years before his passing he realized his condition and that he must have made his great accomplishments and carried forth these great efforts in the face of constant, severe physical limitations which no one but he knew.

Mr. Lindsay was an ornament to our profession. He had qualities which endeared him to his friends. He was the type of man who was more or less retiring, but those who came to know him intimately found a constantly growing respect for his ability and ideas.

Mr. McNab, to my notion, had the ability, as much as anyone I have ever known, of meeting men and immediately making them friends and acquiring their respect and affection. It can not be other than a matter of great regret to the members of this association that we have lost these friends. They are gone, but they have gone with a record of accomplishments, with a record of fine standing. Can any of us hope for anything better when our time comes?

C. A. Morse (C. R. I. & P.): I had the pleasure of becoming personally acquainted with Mr. Baldwin, Mr. McNab and Mr. Lindsay. Mr. Baldwin was a man of inspiring confidence. He apparently took a great interest in whatever concerned the association. Mr. McNab was one of the characters whom I think I can say we all loved. I was a great admirer of him. Mr. Lindsay has properly been spoken of here today as the watch dog of the association. When he got up to speak, one always felt that he was talking about something of which he knew because he had read the report. I think it would be well for all of us, in looking at the past work of these three men and in viewing their accomplishments and considering their character, to hope that when our time comes we can be spoken of as well as they are here today.

Edwin F. Wendt (Washington, D. C.): Mr. McNab was, as you know, a man of large acquaintance. He knew the principal officers of the Canadian Government and he took great pride in his acquaintance and in the knowledge which that gave to him. He had also a wide acquaintance among those in high places at Washington.

My personal acquaintance with Mr. McNab convinces me that he had a broad sympathy for every person and this it seems to me was one of his characteristics which we can emulate for the reason that by doing so we contribute to the welfare of others, and so far as we contribute to the welfare of others, we contribute to our own happiness and our own success.

C. F. Loweth (C. M. & St. P.): It was my great privilege for 12 or 15 years to know Mr. Baldwin. I knew him as a neighbor. I knew him as a fellow engineer. I knew him as a worker in engineering societies. Many of you here today knew him in that way, but I cherish, as I look back over the past years, my acquaintance with Mr. Baldwin which grows dearer to me as the months have gone by since he left us, and that was the association with Mr. Baldwin as a friend. There came to grow out of that association a knowledge of what it means to have a man like Mr. Baldwin as a friend.

(In addition to the remarks which have been abstracted in brief above, tributes were paid to Mr. Lindsay by W. T. Dorrance, W. H. Elliott and J. V. Neubert, each of whom had had a close acquaintance with him through years of intimate association. H. T. Douglas and Professor S. N. Williams in like manner paid their tribute to the memory of A. S. Baldwin, touching on the high regard in which they held his memory as the result of personal contact.)

Report of the Committee on Track

The committee submitted typical plans for double slip switches, crossings, frogs, etc., a part of which were submitted last year as information with the exception that further notes have been added and some slight revisions made. An entirely new subject was presented for inclusion in the Manual in the form of a complete set of specifications for performing maintenance work and laying new track. These specifications cover arrangements with contractors, regarding the type of work and labor, etc., materials, practices on tangents, curves, grades and structures, and methods of procedure from the laying and ballasting of the track to the finished form ready for operation. Results of a questionnaire on the pre-curving of rail indicated that there is a reasonable doubt whether the expense incurred is justified by the results. Of 103 roads answering, 44 precurve rails and 57 did not, eight of the latter recommending it under some circumstances. Results of a questionnaire on the oiling of track indicated that about 53 per cent of the mileage of the country is being oiled, as far as rail and track fixtures are concerned. The extended use of the practice was recommended. W. P. Wiltsee, acting chief engineer, Norfolk & Western, is chairman, this having been his fifth year as chairman and his seventh year as a member.

W. P. Wiltsee
Chairman

THE COMMITTEE RECOMMENDED (1) that the changes in the Manual in Appendix A be approved and the revised version substituted for the present recommendations in the Manual, and (2) that the conclusions in Appendices B, C, D, E, F, G, H and I be approved for publication in the Manual, or accepted as information as recommended in the individual reports.

Appendices E and F were statements showing what work was being carried out on the subjects of the Effect of Brine Drippings on Tie Plates and the Taper of Tread of Wheel. Abstracts of the remainder are presented herewith.

Committee: W. P. Wiltsee (N. & W.), chairman; J. V. Neubert (N. Y. C.), vice-chairman; L. B. Allen (C. & O.), V. Angerer (Wm. Wharton, Jr., & Co.), J. B. Baker (Penna.), R. A. Baldwin (C. N. R.), C. W. Breed (C. B. & Q.), G. H. Bremner (Cons. Eng.), H. G. Clark (C. R. I. & P.), W. P. Cronican (I. C.), E. A. Hadley (M. P.), C. R. Harding (S. P.), W. J. Harris (C. B. & Q.), G. W. Hegel (Union Stock Yds. L. A.),

E. T. Howson (*Railway Age*), T. T. Irving (G. T.), H. A. Lloyd (Erie), J. de N. Macomb (A. T. & S. F.), F. H. McGuigan, Jr. (U. S., R. A.), W. S. McFetridge (B. & L. E.), J. B. Myers (B. & O.), F. L. Nicholson (N. S.), J. H. Reinholdt (M. & St. L.), I. H. Schram (Erie), G. J. Slibeck (Pettibone-Mulliken), J. B. Strong (Ramapo-Ajax), E. D. Swift (Belt Railway), J. R. Watt (L. & H.).

Appendix A—Revision of Manual

Item I

The committee recommended inserting in the Manual the following reference to switch and frog plans:

The design for split switches and split switch fixtures, plans Nos. 101 to 108, inclusive, and plans Nos. 201 to 204, inclusive, and also the designs for spring rail frogs, plans Nos. 401 to 403, inclusive, should apply in all details only to rails below 6½ in. in height.

Item II

The committee recommended that plan No. 253, dated November, 1922, and entitled "Details of Switch Stand Target Shapes," be adopted, and that Section 11 of "Requisites for Switch Stands, Including Rods," adopted March, 1921, be revised to refer to this plan, to read:

11. Shapes and sizes of targets shall conform to Plan No. 253.

There are at present in service switch stand targets of a great variety of dimensions of the same shape or style, the dimensions varying in some instances by only a small fraction of an inch, each set of dimensions requiring expensive individual dies for manufacture. Plan No. 253 should result in standardizing the dimensions of styles in most common use. This plan shows a sufficient variety of shapes and sizes to meet operating requirements.

Appendix B—Typical Plans for Double Slip Switches, Crossings, Frogs, Etc.

The committee recommended that the following plans be adopted as recommended practice and printed in the Manual:

Plan No. 801, No. 8 double slip switch with movable center points with uniform risers.

Plan No. 802, No. 8 double slip switch with movable center points with graduated risers.

Plan No. 851, details of No. 8 double slip switch with movable center points with uniform risers.

Plan No. 852, details of No. 8 double slip switch with movable center points with graduated risers.

Plan No. 700A, data and record sheet for ordering crossings.

Plan No. 700A, example No. 1 illustration as applied to A. R. E. A. Designs.

Plan No. 700A, example No. 2, illustration as applied to plans other than A. R. E. A. design.

The committee also recommended that the assignment of plan No. 700 to Application of A. R. E. A. Crossings Designs and Recommended Practices, adopted March, 1922, be approved.

Plan No. 420, data for laying out spring rail frogs, dated November, 1922.

The committee also recommended that Plan No. 770 and the report on the subject of Insulated Internal Joints for Crossings be received as information only.

Appendix C—Specifications for Performing Maintenance Work and Laying New Track

The committee recommended that the following specification be adopted as recommended practice and printed in the Manual:

Specifications for the Laying of New Track

(1) The work covered by these specifications will include the laying and ballasting of the tracks mentioned, ready for the operation of trains.

(2) The railway company's authorized representative shall arrive at a clear understanding with the contractor as to the force to be employed and the speed with which the work shall proceed. Prior to starting the work the contractor shall notify the railway company's representative a sufficient time in advance so that adequate arrangements can be made for the prosecution of the work.

(3) The railway company will furnish all track materials on cars (or on the ground in the material yard at .....).

(4) The contractor shall provide all tools needed in connection with this work.

(5) The railway company will provide the necessary inspector or inspectors and the instructions of such inspectors regarding the quality and type of work to be done shall be complied with at all times by the contractor.

(6) The contractor shall supply the necessary foremen and labor to prosecute the work properly and in such numbers as may be required by the chief engineer or his authorized representative, and at the request of the chief engineer or his representative will remove any foreman or man not satisfactory to the railway company.

(7) No track shall be laid and no track materials shall be placed on the roadbed until the sub-grade shall have been constructed and finished to true planes according to the stakes set by the representative of the railway.

(8) The railway company's representative shall set all center and grade stakes, which stakes shall be followed by the contractor in lining and surfacing track.

(9) ..... Hewn or ..... sawn ties shall be laid in each 33-ft. panel in main tracks and ..... ties shall be laid in each 33-ft. panel in side and yard tracks. They shall be spaced uniformly and laid at right angles to the rail with the ends lined uniformly as may be specified.

(10) Ties must be laid with the heart side down.

(11) Ties must be adzed carefully, giving full bearing with the least possible cutting of ties. The bottom of the rail, the tie plate and the bearng surface of the tie shall be cleaned before the rail is laid.

(12) Tie plates, when furnished, must be applied in a workmanlike manner at time rail is laid to avoid unnecessary spiking and must be so placed that the shoulder is in contact with the base of rail or the splice bar for the entire length of the shoulder.

(13) Metal expansion shims must be used to provide for the proper openings between the rails and a thermometer shall be used to determine the thickness of the shims to be used, in accordance with the standards of the A. R. E. A.

(14) Necessary gaging must be done at the time rail is laid and should conform to the railway company's standard practice.

(15) All joints must be full bolted and rails drilled where necessary.

(16) All bolts must be tightened before track is turned over to operation.

(17) In laying rail on tangents the staggering of joints must be provided and in laying rail on curves care must be taken to put in short length rails at proper intervals in the low rail and to maintain the proper stagger throughout the curve.

(18) As far as possible all joints should be kept out of street and road crossings.

(19) Rails must be fully spiked to each tie in accordance with the standards of the railway. The inside and outside spikes shall be as far apart as the face and character of the tie will permit. The inside spikes shall be on the same side of the tie.

(20) All spikes shall be started and driven vertically and square with the rail and so driven that the face of the spike shall have a full hold on the base of the rail.

(21) On bridges and trestles no spikes shall be driven in slots or against the ends of the angle bars, neither should track be anchored to the bridge in any way.

(22) Rail anchors shall be applied in accordance with the standards of the railway company at the time the track is laid. Care should be taken to give them a firm bearing against the ties when installed.

(23) On curves the outer rail shall be given superelevation according to the railway company's standard practice.

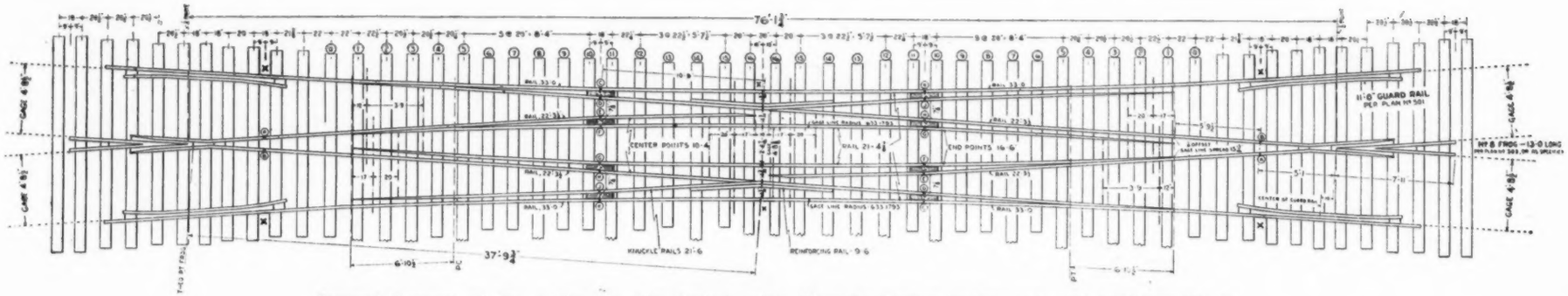
(24) All switches, frogs and guard rails must be placed in accordance with the railway company's standards.

(25) Switches must be left in proper adjustment, special care being given to the bending of the stock rail.

(26) The railway company shall furnish all ballast as required and shall transport and switch such ballast free of cost to the contractor to the point where it is to be applied.

(27) Ballast shall be unloaded by the contractor by dumping or plowing as the means provided by the railway company permit. If the ballast is in center dump cars it shall be unloaded by having one or more cars opened at a time, allowing the required amount of ballast material to flow out as the train is moved along slowly. If the material is on flat or open cars, it shall be plowed off by means of an unloading machine while the train is moving at such a rate of speed as to provide the desired amount of material as uniformly distributed as possible. The unloaded material shall be leveled down by means of a ballast plow or spreader. Care shall be taken not to destroy or disturb the grade stakes.

(28) The preliminary surfacing gang shall follow the unloading as closely as the regularity of the ballast supply will permit. In using jacks, they must be placed close enough together to prevent undue bending of the rail or strain on the joints. Both rails



General Layout of No. 8 Double Slip Switch with Movable Center Points and with Uniform Risers

A. R. E. A. DESIGNS

FOR RECOMMENDED PRACTICE SEE PLAN No. 700

STANDARD DESIGN PLAN NOS (CHECKMARK PLAN NUMBER OF DESIGN DESIRED)

BOLTED RAIL CROSSINGS

THREE RAIL DESIGN
- ✓ PLAN 701, 90° TO 50° INCL.
- ☐ PLAN 703, BELOW 50° TO 35° INCL.
- ☐ PLAN 705, BELOW 35° TO 25° INCL.

TWO RAIL DESIGN
- ✓ PLAN 702, 90° TO 50° INCL.
- ☐ PLAN 704, BELOW 50° TO 35° INCL.
- ☐ PLAN 706, BELOW 35° TO 25° INCL.
- ☐ PLAN 708, BELOW 25° TO ABOVE 14°-17"
- ☐ PLAN 710, 14°-17" TO 8°-19" INCL.

TWO RAIL DESIGN WITH SHORT EASER RAILS
- ☐ PLAN 707, BELOW 25° TO ABOVE 14°-17"
- ☐ PLAN 709, 14°-17" TO 8°-19" INCL.

SINGLE RAIL DESIGN
- ☐ PLAN 706, BELOW 25° TO ABOVE 14°-17"
- ☐ PLAN 710, 14°-17" TO 8°-19" INCL.

SINGLE RAIL DESIGN WITH SHORT EASER RAILS
- ☐ PLAN 707, BELOW 25° TO ABOVE 14°-17"
- ☐ PLAN 709, 14°-17" TO 8°-19" INCL.

MANGANESE STEEL INSERT CROSSINGS

THREE RAIL DESIGN
- ☐ PLAN 754, DETAIL "A" 45° TO 35° INCL.
- ☐ PLAN 755, DETAIL "B" 45° TO 35° INCL.
- ☐ PLAN 756, DETAIL "A" BELOW 35° TO 25° INCL.
- ☐ PLAN 761, DETAIL "B" BELOW 35° TO 25° INCL.

TWO RAIL DESIGN
- ☐ PLAN 756, DETAIL "A" 45° TO 35° INCL.
- ☐ PLAN 757, DETAIL "A" BELOW 35° TO 25° INCL.
- ☐ PLAN 759, DETAIL "A" BELOW 25° AND ABOVE 14°-17"
- ☐ PLAN 767, 14°-17" TO 8°-19" INCL.

TWO RAIL DESIGN WITH SHORT EASER RAILS
- ☐ PLAN 756, DETAIL "B" BELOW 35° TO 25° INCL.
- ☐ PLAN 758, DETAIL "A" BELOW 25° TO ABOVE 14°-17"
- ☐ PLAN 759, DETAIL "B" BELOW 25° TO ABOVE 14°-17"

SINGLE RAIL DESIGN
- ☐ PLAN 761, DETAIL "A" BELOW 35° TO ABOVE 14°-17"
- ☐ PLAN 768, 14°-17" TO 8°-19" INCL.

SINGLE RAIL DESIGN WITH SHORT EASER RAILS
- ☐ PLAN 759, DETAIL "A" BELOW 25° TO ABOVE 14°-17"
- ☐ PLAN 769, DETAIL "B" BELOW 25° TO ABOVE 14°-19"

GAGE & FLANGEWAY

ON TANGENT: GAGE 4 ft. 8½ in. FLANGEWAY: 1¾ in.
ON CURVE: GAGE ..... FT. ..... IN. FLANGEWAY: ..... IN.
A. R. E. A. GAGES & FLANGEWAYS WILL BE USED UNLESS OTHERWISE SPECIFIED.

FOR CURVED CROSSINGS AND A. R. E. A. GAGES AND FLANGEWAYS CHECKMARK CONDITIONS OF OPERATION.
- ☐ FOR AVERAGE MAIN LINE CONDITIONS
- ☐ FOR YARD OR SIDINGS, WHERE MAIN LINE LOCOMOTIVES DO NOT OPERATE.
- ☐ FOR OPERATION ON CURVE OF MAXIMUM
  - LOCOMOTIVE WITH ..... PAIRS
  - OF FLANGED DRIVERS & ..... FT. RIGID WHEEL BASE.

ALTERNATE & OPTIONAL FEATURES IN A. R. E. A. DESIGNS

CHECKMARK FEATURES DESIRED—UNLESS SO SPECIFIED, CROSSINGS WILL BE BUILT TO A. R. E. A. STANDARD DESIGN, WITH OPTIONAL FEATURES LEFT TO THE JUDGMENT OF THE MANUFACTURER. SEE "RECOMMENDED PRACTICES" PARA. 4.

- ✓ PLATES WANTED. Crossing No. 183-184-185.
- ☐ PLATES NOT WANTED. Crossing No. .....
- ☐ SQUARE CORNER PLATES (STANDARD FOR CROSSINGS ABOVE 25°-17')
- ☐ CORNER PLATES CUT OUT FOR TAMPING (ALTERNATE FOR BOLTED RAIL CROSSINGS 90° TO 25° INCL.)
- ✓ CONTINUOUS PLATES UNDER THRU RAILS. See remarks R. R.
- ☐ UNDER CUT RAILS R. R. (ALTERNATE FOR BOLTED RAIL CROSSINGS 90° TO 35° INCL.)
- ☐ SPECIAL TIE PLATES (ALTERNATE FOR CROSSINGS 14°-17' TO 8°-19' INCL.)

ALTERNATE CONSTRUCTION FEATURES IN STANDARD DESIGNS.

(TO BE SPECIFIED IF DESIRED.)
- ✓ INTERLACED CORNER CONSTRUCTION (ALTERNATE FOR BOLTED RAIL CROSSINGS 90° TO 35° INCL.)
- ☐ THRU RAILS CUT AT FLANGEWAY NOTCH (OPTIONAL FOR BOLTED RAIL CROSSINGS 90° TO 35° INCL.)
- ☐ MITERED MAIN RAILS (STANDARD FOR BOLTED RAIL CROSSINGS. THREE RAIL DESIGN, BELOW 35° TO 30° INCL. ALTERNATE FOR THREE RAIL DESIGN BELOW 30° TO 25° INCL. FOR TWO RAIL DESIGN 35° TO ABOVE 90°.)
- ☐ REINFORCEMENTS FOR BENT MAIN RAILS (ALTERNATE FOR BOLTED RAIL CROSSINGS. TWO RAIL DESIGN WITH BENT MAIN RAILS BELOW 30° TO 25° INCL.)
- ☐ ONE PIECE JOINTS IN EASER RAILS BETWEEN INTERSECTIONS (ALTERNATE FOR MANGANESE INSERT CROSSINGS BELOW 25° TO 25° INCL.)

ADDED FEATURES. IF DESIRED
- ☐ STANDARD SPLICE BARS TO BE FURNISHED WITH CROSSINGS.
- ☐ ARMS EXTENDED TO BRING END JOINTS OPPOSITE. (FOR CROSSINGS 90° TO 30°.)
- ☐ GUARDS EXTENDED BEYOND END JOINTS OF RUNNING RAIL. (FOR CROSSINGS OF THREE RAIL OR TWO RAIL DESIGN ABOVE 25°.)
- ✓ EASER RAILS EXTENDED BEYOND END JOINTS OF RUNNING RAIL. (FOR CROSSINGS OF THREE RAIL DESIGN.)
- ☐ OTHER SPECIAL FEATURES (DESCRIBE).....

LOCATION. *Kansas City, Mo.*

REQUISITION No. *M. W. 1506* DATE. *6-7-22*

NUMBER OF CROSSINGS ON REQUISITION. 3 NUMBERED- *183-184-185*

DESIGN. *A. R. E. A. Plan No. 701 for No. 184*
A. R. E. A. Plan No. 702 for Nos. 183 and 185

SPECIFY A.R.E.A. DESIGN, STANDARD PLAN OF R.R. CO., OR MANUFACTURER'S DESIGN

RAIL SECTION. SECTION: *A.R.A.—A* 90 LBS. PER YD.

END DRILLING. SEE SKETCH: *A.*

GAGE & FLANGEWAYS. *As Specified*

A. R. E. A. GAGE & FLANGEWAYS WILL BE USED UNLESS OTHERWISE SPECIFIED

PLATES. *As Specified*

DESCRIBE PLATES WANTED OR CHECKMARK UNDER A. R. E. A. DESIGNS.

	NO. OF PAIRS	JOINTS MARKED	CONNECTING SECTION	SECTION WEIGHT	SPLICE DRILLING	AMOUNT OF TOP WEAR
COMPROMISE JOINTS	8	1-2-3-4 9-10-11-12	A S.C.E.	85#	B (SEE SKETCH)	None
	4	5-6-7-8	A.S.C.E.	75#	C	1/8"

NEW RAIL OF SAME RAIL SECTION AS CROSSING SHOULD ABUTT CROSSING.

SPLICE BARS & BOLTS.

Manufacturer will furnish all special splice bars & special bolts.

STANDARD SPLICE BARS & BOLTS WILL BE FURNISHED ONLY WHEN SPECIFIED.

MARKING- *Mark each separate part of crossing as shown: 183 A, 184 B, etc.*

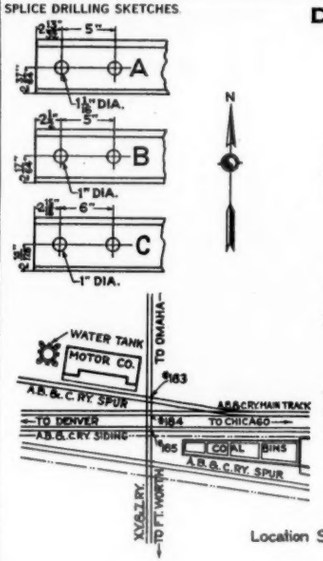
MAINTAINED BY- *A. B. & C. R. R.*

CROSSING TIMBERS- *Right angles to A. B. & C. R. R. for Crossing No. 184. Right angles to X. Y. &Z. R. R. for Crossings Nos. 183 & 185 All 7" x 9" Timbers.*

REMARKS- *Thru Rails on A. B. & C. Ry track Crossing 184. Thru Rails on X. Y. Z. Ry track Crossing 183 and 185. Extend Easer Rail in crossing 184 beyond end joints on A. B. & C. Ry track only.*

CROSSING RECEIVED: DATE *8-2-22* INSTALLED: DATE *11-3-22*

SPLICE DRILLING SKETCHES

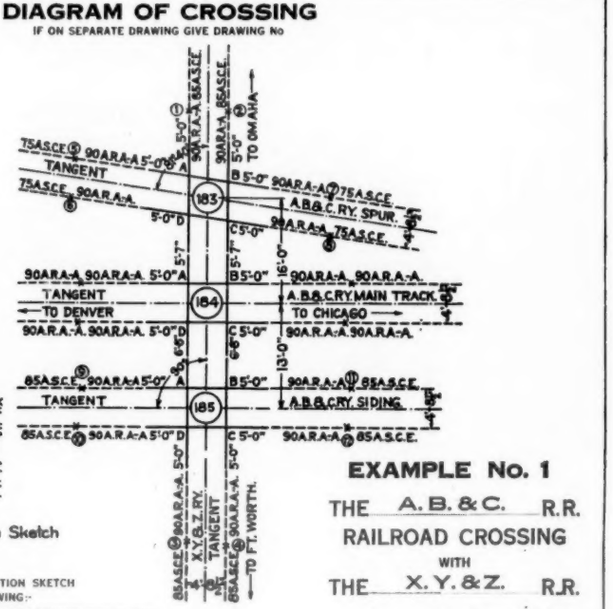


THIS SPACE TO BE USED FOR LOCATION SKETCH & DIAGRAM OF CROSSING SHOWING:-

1. GAGE OF TRACKS.
2. CENTRAL ANGLE BETWEEN INTERSECTION OF C. L.
3. DIRECTION & RADIUS OF CURVE IF ANY.
4. ANN LENGTH MEASURED FROM THEORETICAL INTERSECTION OF GAGE LINES.
5. DISTANCE BETWEEN CROSSINGS MEASURED FROM INTERSECTIONS OF CENTER LINES.
6. CROSSING NUMBERS.
7. LETTERS MARKING SEPARATE PARTS OF CROSSING
8. NAME OF INTERSECTING LINE.
9. NORTH AND SOUTH ARROW.

DIAGRAM OF CROSSING

IF ON SEPARATE DRAWING GIVE DRAWING No



EXAMPLE No. 1

THE A. B. & C. R.R.
RAILROAD CROSSING
WITH
THE X. Y. & Z. R.R.
AT KANSAS CITY, MO.

DATA & RECORD SHEET FOR ORDERING CROSSINGS—PLAN No. 700-A

Data and Record Sheet for Ordering Crossings—Plan No. 700-A

must be raised at one time and as nearly uniformly as possible. The track shall be so lifted that after a period of not less than three days after the last lift it will be necessary to give it a final lift of not less than one inch nor more than two inches to bring it to the grade of the stakes. All ties that are pulled loose shall be replaced to proper position and must have a bearing against the rail and be fully spiked, with all spikes driven home before tamping. Spikes must not be straightened while being driven. Ballast shall be well packed or tamped with pick, shovel, tamping bar or tamping machine, as directed, from a point 15 in. inside of each rail on both sides of the ties to the end of the ties, tamping the outside of the tie first.

(29) When the track has been raised to within one or two inches of the final grade and properly compacted by traffic, a finishing lift shall be made by jacking up the track to the exact height provided for by the grade stakes. All allowance for settlement shall be taken care of in the setting of the stakes and the necessary ballast forked or shoveled in, and then driven to place by tamping machines, tamping picks, bars or shovels, as directed by the proper representative of the railway company. In making the finishing lift the spot board and level board must be used with care and the track brought to a true surface.

(30) The track shall be placed in good alinement before the finishing lift is made, but a lining gang shall follow one or two days behind the finishing lift and shall spot up all places found not holding up to proper surface, and shall line the track to accurate alinement. Stakes shall be set for the alinement before the finishing lift is made and the final alinement must conform to the stakes.

(31) The contractor shall trim the ballast to conform to the standard roadbed section, and the railway company for this purpose shall supply its standard cross-section template. The portion of the sub-grade outside the ballast line shall be left with a full even surface and the shoulder of the embankment properly dressed to the standard roadbed section. The contractor shall dispose of any surplus ballast after trimming the ballast section as directed by the representative of the railway company.

(32) If as the work proceeds ballasting shall lag behind the track laying or if for any other cause the track shall require a running surface to prevent the bending of rails or injury to the track by reason of trains being operated over the track at moderate speeds, such work shall be done on the written order of the representative of the railway, who shall specify the stations between which such work shall be done.

(33) The contractor shall install and secure promptly all stockguards, crossing plank and similar facilities adjacent to or forming a part of the track.

(34) The contractor shall remove from the railway company's property all rubbish and waste from the work, or dispose of it as directed by the representative of the railway company. After completing the work the contractor shall remove from the railway company's property, and from all public and privately-owned property, at his own expense, all temporary structures and waste resulting from his camping operations.

(35) The contractor is to understand that any work not specifically mentioned in the specifications, but which is necessary, either directly or indirectly, for the proper carrying out of the intent thereof, shall be required and applied, and he shall perform all such work just as if it were particularly delineated or described. Unless specifically mentioned above, all work shall conform to the standards of the railway company.

Appendix D—Plans for Switch Stand Targets and Switch Locks

Item 11, plan No. 253, in Appendix A, "Detail of Switch Stand Target Shapes," was presented for adoption as a supplement to the Manual, completing Section 11 of Requisites for Switch Stands, adopted March, 1921.

Plan No. 255, dated November, 1922, and entitled "Switch Lock," was presented and recommended for adoption as recommended practice. The plan is practically the same as the one presented last year. This plan gives the essential dimensions of the shackle, the names of the parts and specification that will permit the use of good standard locks now on the market, and that will at the same time eliminate locks made of light or improper material. It has been thought impractical to standardize the internal mechanism of the lock, especially as there are a number of good designs varying considerably in detail, most of which are covered by live patents.

Appendix G—Study and Report on Curving of Rails

The Committee on Rules and Organization reported in connection with Rules for Laying of Rail, Volume 13, pages 67 and 928—"Rails for curves four degrees and over, should be curved before laying." This rule was accepted and printed in the 1915 Manual. The present recommended practice is given in Volume 22, Proceedings for 1921, page 828, paragraph 262, in which the Rules Committee submitted the following: "Except on very sharp curves, much sharper than usually found in main line tracks, rail should be curved before laying."

To detemine the present day practice of the various railroads who are members of the Association, a questionnaire was sent to the railroads repesented.

Railroads That Do Not Pre-Curve Rail Before Laying

A., C. & Y.; A. A.; A., B. & A.; A. C. L.; B. & O.; B. & L. E.; B., R. & P.; C., C. & O.; C. of G.; C. R. R. of N. J.; C. V.; C. & W. C.; C. & O.; C. & A.; C., I. & L.; C. R. & I.; C., M. & St. P.; C. & N W.; C. N.; C., C., C. & St. L.; C. R.; D. L. & W.; D. & T. S. L.; D., M. & N.; E., I. & T. H.; E., J. & E.; Ft. S. & W.; G., M. & N.; G. & S. I.; G. T.—Western Lines; H. V.; K. & M.; L. & N. E.; L. V.; L. & N.; L. E. & W.; N. Y., O. & W.; N., C. & St. L.; N. Y. C. & St. L.; N. Y. C. (West of Buffalo); N. & W.; P. & P. U.; P. M.; P. & R.; P. & W. V.; R., F. & P.; Rutland; S. A. & A. P.; S. A. L.; Southern; T., St. L. & W.; T. & O. C.; T. M.; U. R.; W. T.; W. M.; W. & L. E.

Eight of the above railroads recommended precurving rails as follows:

Ann Arbor recommends precurving rail on curves 5 deg. and over.

Central of Georgia discontinued practice of 1921, as they have no curves over 7 deg., but recommend precurving on curves exceeding 8 deg. for 75-lb. rail and over for main line use.

Chicago & Alton recommends precurving on curves 15 deg. and over for rail 80 lb. and over.

Lake Erie & Western recommends precurving for 12 deg. and over.

New York, Ontario & Western recommends curving all rail above 70 lb. for over 4 deg. if expense is reasonable.

Norfolk & Western recommends precurving 85 lb. to 130 lb. for curves 8 deg. and over if it can be shown that the cost of precurving will be offset by the saving in labor necessary to maintain proper alignment on curves.

Peoria & Pekin Union recommends precurving main line, 60 lb. to 70 lb. curves over 6 deg., side track, 12 deg.; above 70 lb.; main track, 4 deg., side track 6 deg.

Wheeling & Lake Erie recommends precurving 90 lb. rail and over for 10 deg. and over.

Conclusions

Analysis of the data showed that of the 103 roads answering the questionnaire, 44 precurve rails. Fifty-seven do not, but eight of the latter recommend that under various conditions the practice be followed, and that six precurved rail at one time, but discontinued the practice, as results obtained did not justify the expense. The practice of precurving rails differs widely in the same section of country, even where the physical and operating conditions of roads in the section are much the same. It, therefore, would seem to be very much a matter of opinion as to whether the results obtained in precurving rail justifies the expense.

The committee was not ready to make definite recommendations at this time and desired to give further study to the ultimate economy of this practice and the effect on stresses in the rail.

Appendix H—Report on the Use of Guard Rails on Curves

A questionnaire was sent out to the railroads in the Association as to the use of guard rails. Replies were received from 64 railroads.

After a study of the subject and answers to the questionnaire the committee offered the following conclusions as information:

1. The general use of guard rails for protecting curves is not recommended. The use of guard rails for protecting extremely

sharp curves in special locations is desirable, especially on heavy grades where superelevation is a compromise between requirements of passenger and freight service, or where there is no superelevation of the outer rail.

2. The principal function of guard rails is to prevent derailments. Guard rails placed and maintained as per tables No. 1 and No. 2, plans No. 791 and No. 792, adopted March, 1922, will decrease the side wear on the outer rail and wear on the gage side of the flange of wheels.

3. The top of the guard rail should not be lower than the plane of the top of the traffic rail—preferably in the same plane.

4. Local conditions will govern as to whether the advantage of the use of guard rails outweigh the disadvantages on added cost of track structure and maintenance.

5. It is recommended that allowable speeds are not to be increased on curves because guard rails are installed.

6. Tables 1 and 2, plans No. 791 and No. 792, adopted March, 1922, should be used for determining flangeways in placing guard rails for various types of locomotives.

Appendix I—Results Obtained From Oiling Track Fixtures

The oiling of rail, switch and track fixtures has been experimented with to a greater or less extent for the past ten years—in fact, the oiling of certain switch fixtures has always been practiced by railways, but the more recent developments have been in the oiling of angle bars and track bolts, particularly on the main traffic lines of various railroads, and further, due to the action of brine drippings from refrigerator traffic, as well as to other conditions local to individual roads, these roads are now oiling, not only the joints and bolts, but the entire steel track structure as well.

Total mileage of Class I Railroads in the United States, exclusive of switching and terminal companies .....234,676.43 miles

Total mileage of Class I Railroads in the United States answering who oil their rail or track fixtures .....125,595.70 miles, or 53.6 per cent

Total mileage of Class I Railroads in the United States answering who do not oil their rail or track fixtures ..... 52,074.51 miles, or 22.2 per cent

Total mileage of Class I Railroads in the United States not answering questionnaire ..... 57,006.22 miles, or 24.2 per cent

Conclusions

The conclusions of the Committee on Track at its meeting in Cleveland, Ohio, November 21, 1922, were the recommendation of the following practices for publication in the Manual:

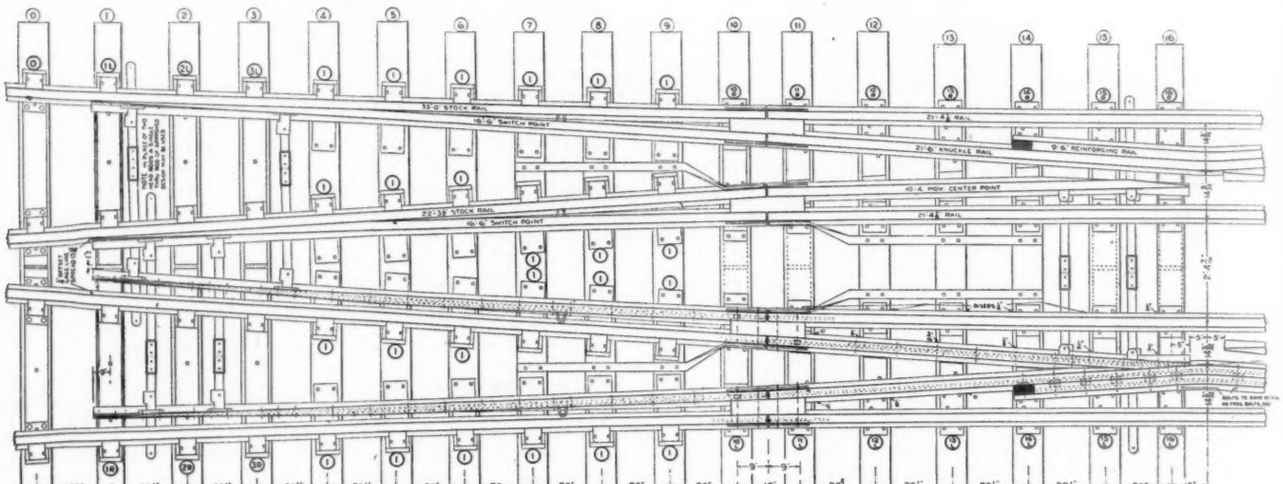
1. Oiling track bolts.
2. Oiling splice bars.
3. Oiling turnout fixtures.
4. Oiling rail, tie-plates and spikes when subjected to special corrosive conditions when ultimate life is affected.
5. Oiling to be done twice a year—preferably in May and October—and only when the material is dry.
6. Oiling of rail, tie-plates and spikes to be done by machine; other materials by brush; new track bolts and joints to be oiled before applying.
7. Satisfactory oil for this purpose should conform to the following general specifications:

Asphalt Base Dipping Oil—Specifcations:

Flash Point .....130 deg. F.
Asphalt, 100 penetration.....Min. 45 per cent
Viscosity, Saybolt Universal, 100-150 deg. Fahrenheit .....140-375 sec.

Discussion

(Mr. Wiltsee, the chairman, outlined his report and *moved the adoption of Item 1 and its insertion in the Manual. Motion carried.*)



Details of No. 8 Double Slip Switch with Movable Center Points and with Uniform Risers

Mr. Wiltsee: Item No. 2, the committee recommends that plan 253 be adopted by the Association for insertion in the Manual.

(*Motion carried.*)

J. V. Neubert (N. Y. C.), chairman of sub-committee: We have had published in the previous bulletins plans for the Number 8 slip, and I submit that the plans of the committee, Numbers 800, 801, 802, 851, 852 for adoption. *I so move.*

(*Motion carried.*)

Mr. Neubert: We have been asked to get up a drawing to show a simplified method of ordering crossing frogs, and in doing that we have prepared Plan 700-A, showing the data and record sheets for ordering crossing frogs. We have also Plan 700-A, Example 1, showing the way crossing frogs should be ordered. *I move that this be adopted.*

(*Motion carried.*)

Mr. Neubert: The committee was asked to make up plans for rail frogs other than angles 8, 10 and 11, which have been adopted by this association, so we have prepared a plan or table covering the details for frogs of angles 7, 9 and 11, and we submit this for adoption. *I move its adoption. Motion carried.*

(E. T. Howson (*Railway Age*) presented the report of the sub-committee on "Specifications for performing maintenance work and laying new track," as contained in Appendix C.)

Z. M. Briggs (Penna.): I want to call attention to paragraph 11, "Ties must be adzed carefully, giving full bearing with the least possible cutting of ties." I wonder if we should not say *should not be adzed,* in consideration of the increasing use of treated ties.

(*A motion to adopt was carried.*)

C. W. Breed (C. B. & Q.) then presented the report of the sub-committee on Switch Stand Targets and Switch Locks, including a plan of a switch lock. *It was moved and subsequently carried that the plan be adopted as standard.*

The reports of the sub-committees on Tie Plates and the Effect of Brine Drippings on Track Appliances were then presented by the respective sub-committee chairmen and received as information. H. G. Clark (C. R. I. & P.) then outlined the report on Oiling Track Fixtures, and *a motion that the report be published in the Manual was carried.*

The committee was then dismissed with the thanks of the association.

Report of Committee on Rules and Organization

The Committee on Rules and Organization is in a peculiar position owing to the fact that all rules governing officers and employees except those involving matters of discipline must have some bearing on the manner of conducting the work. Therefore, the work of this committee frequently tends to overlap that of other committees dealing with particular phases of maintenance of way. As an example, the matter presented in Appendix A of the committee's latest report conflicts in a measure with work being done by the Committee on Economics of Labor. The organization of forces for the conduct of particular classes of work would seem to come within the scope of the Committee on Rules and Organization, yet organization is an important factor in the economics of labor utilization. In an appendix of its report, the committee presented matter clearly within its own province—nomenclature for the guidance of the foreman in preparing reports. The matter is elementary. Nevertheless, it may serve as a real help to men who have as limited education as many foremen now employed. For the past three years the chairmanship of the Committee on Rules and Organization has been held by W. C. Barrett, trainmaster, Lehigh Valley, who has seen service with the committee for the last five years.

W. C. Barrett
Chairman

THE COMMITTEE PRESENTED reports covering the use of mechanical appliances and tools (Appendix A) and a Uniform Nomenclature for Maintenance of Way Operation and Materials. The latter was drawn primarily for the aid of the foreman in preparing reports. The committee's report was presented as information only.

Committee: W. C. Barrett (L. V.), chairman; E. H. Barnhart (C. & E. I.), vice-chairman; F. D. Anthony (D. & H.), D. P. Beach (Penna.), H. L. Browne, E. N. Burrows (Cornell U.), S. E. Coombs (N. Y. C.), J. L. Downs (I. C.), H. H. Edgerton (C. G. W.), C. W. Engle (C. C. C. & St. L.), J. M. Fair (Penna.), H. A. Gerst (G. N.), R. H. Hallsted (M. P.), H. H. Harsh (B. & O.), B. Herman (Sou.), J. E. Hood (Uintah.), B. R. Kulp (C. & N. W.), E. F. Manson (C. R. I. & P.), E. L. Martin (Hutt Contr. Co.), R. N. Priest (A. T. & S. F.), R. E. Warden (M P.), A. A. Woods (Sou.).

Appendix A—Mechanical Appliances and Tools, With Organization Involved

Supervisor of Work Equipment: Reporting to the chief engineer, or to the chief engineer of maintenance. This officer's duties include the following:

He has charge of all work equipment, including hoist or clam shells, in the yards, at the engine house or out on line; hoists in the store department; steam shovels; ditchers; spreaders; motor cars; weed mowers; tie tampers; rail layers; portable rail saws, etc.

He arranges for systematic inspection of equipment; instructs operators in charge of equipment; has charge of all equipment inspectors; and has general supervision over district or division repairmen on special equipment; he also arranges for distribution of equipment and transfer of equipment when so directed by his superior officer; and has charge of repair shops where machines are repaired if there is sufficient work to justify one shop, otherwise he instructs and directs shop superintendent as to nature and amount of repairs to be done.

Employees.—Engineers on hoists and everyone above the rank of laborer on all steam work equipment are employed by the supervisor of work equipment and then are turned over to the division forces. But they must be satisfactory to the division men to whom they report. They are responsible to the supervisor of work equipment only for care of the machine they are in charge of. These men are considered "system men" and go where the machine goes and keep the same machine.

Organization of Outfits

Steam Shovels.—Moved over the system as a unit with auxilliary equipment including a shovel, bunk car, tool car and dump cars. The crew includes an engineer, craneman, fireman and watchman employed by the supervisor of work equipment and carried on the division payroll.

Ditchers.—Each one is considered as a complete unit and moved together over the system. It consists of: ditcher, flat car, dump car, bunk car, spreader and clam shell attachment. The crew includes an engineer and fireman employed as wanted through the supervisor of work equipment. Labor is employed by the division where the machine is in operation.

Locomotive Crane.—Equipment includes a crane, bunk car and boom car. The crew consists of an engineer and fireman employed as wanted by the supervisor of work equipment.

Spreader.—One operator employed as wanted by the supervisor of work equipment.

System of Repairs

Inspected.—Repair parts are ordered and sent to where repairs are to be made. The work list is made out showing what is to be done. The engineer of the machine is sent to the shop where the repairs are made and oversees the work done.

Distribution of Machines

The distribution for the season is fixed by the supervisor of work equipment in conference with the chief engineer or chief engineer of maintenance of way, or whoever decides for the whole system what the outline of the season's expenditures is going to be.

Points to Consider.—Men who operate the machines should be so assigned as to be nearest their homes. New machines should be put on the hardest work. If rock work, be governed accordingly. Sources of water and fuel for the machines come in for thorough consideration. The individuality of the men is better adapted to some locations than to others. A little powder work of blasting can be done by some men and not by others.

Division Repair Shops

These are used for motor cars only—division repair shops under the control of the division engineer; but they can also be used to

repair track mowers and other small maintenance of way equipment.

Motor Cars

District Inspector.—One to about 4,000 miles—700 cars. Reports to engineer of maintenance of way of the district. Looks after motor cars and tie tampers.

Division Inspectors.—One or two motor car inspectors to each division, 30 to 40 cars to each inspector. He reports to division engineer. Each has a standard list of parts, and keeps in stock one or two extra power-plants, motor engines for the cars. Travels on a motor car of his own, and carries an outfit of tools, and small repair parts. He makes minor repairs and adjustments in the field and instructs the foremen in the care and operation of the cars. If he finds a bad power plant on a car, too bad to be repaired on the ground, he sends in for his extra engine and when it arrives installs it. He does not handle steam shovels or water service.

Reports on Motor Cars

Each car the inspector inspects and repairs he reports on and the report is signed by the foreman, to whom car is assigned. This gives the supervisor information on what their foremen are doing to keep up their cars.

Discussion

(The report was presented by W. C. Barrett, chairman, who turned over the submission of the sub-committee reports to the sub-committee chairmen. Except for a discussion of one method of unloading rail, the entire report of the committee was received without comment and the committee was dismissed with thanks.)

Report on Economics of Railway Labor

No committee is more dependent on the co-operation received from the membership at large for its results than the Committee on Economics of Railway Labor. This point was emphasized by the committee in its Appendix B concerning the standard methods for performing maintenance of way work for the purpose of establishing units of measure of work performed. The establishment of economic methods is essentially a study of details in each individual item of work and the committee has designated the renewal of rail out of face and the renewing of cross ties as the first two operations it desires to analyze. Its report contained suggestea forms for recording the conduct of this work and the reporting of results to the committee, urging that members co-operate in carrying out such studies in order that the committee may obtain the necessary data. Appendix A of the committee report called attention to the analysis of labor problems contained in L. F. Loree's book, "Railway Freight Transportation." The committee proposes to amplify his study of railway conditions by an investigation of the methods and results obtained by steel and oil companies and other manufacturers in the selection and care of employees. C. E. Johnston is completing his second year as chairman and his fifth year as a member.

C. E. Johnston
Chairman

THE REPORT OF THIS COMMITTEE included an appendix A which comprised an extensive quotation from that portion of L. F. Loree's book on "Railroad Freight Transportation" concerning labor relations. In Appendix B, the committee presented forms for the study and reporting of the detailed operations of rail and cross tie renewals and urged full co-operation on the part of the membership in supplying data on these operations in accordance with the forms submitted.

Committee: C. E. Johnston (K. C. S.), chairman; C. H. Stein (C. of N. J.), vice-chairman; J. R. Sexton (Erie), A. N. Reece (K. C. S.), A. F. Blaess (I. C.), G. M. O'Rourke (I. C.), R. H. Ford (C. R. I. & P.), John C. Sesser (Cuba Ry.), J. L. Starkie (G. C. & S. F.), John Evans (M. C.), T. T. Irving (C. N. R.), R. L. Pearson (N. Y. N. H. & H.), C. C. Cook (B. & O.), R. H. Gaines (T. & P.), L. C. Hartley (C. & E. I.), A. L. Grandy (P. M.), W. H. Penfield (C. M. & St. P.), Earl Stimson (B. & O.), L. E. Dale (Penna.), J. L. Haugh (U. P.), E. R. Lewis (M. C.).

Appendix B

Methods for Performing Maintenance of Way Work the Purpose of Establishing Units of Measure of Work Performed

PART 1

The report on this subject submitted last year, and adopted for publication in the Manual, outlined a method for standardizing the performance of the various items of maintenance of way work for the purpose of establishing units of measure of work performed, and contained forms to serve as guides for those who may apply the plan. This plan was applied by one of the large carriers of the Middle West to determine by actual test the amount of work of various classes which could be performed per man hour. This unit was established by selecting a first-class gang on each division and arriving at a unit for performing the various classes of work by keeping an accurate record of the time spent on each class of work.

After the establishment of such a unit, each supervisor was instructed to allocate his work as between the different foremen at the beginning of each month, and also carefully plan the work of each foreman, and after the amount of each class of work was allocated, he was allowed a specified number of man hours for doing each kind of work. The foreman was required to keep a record each day of the amount of work done and the hours consumed in performing it.

This was done on a number of divisions, and a summary of the results obtained is shown in the following table:

Item	Quantity	Man-Hours	Units Per Man-Hour
Renewing Ties:			
(a) In rock and cementing gravel ballast	6,829 ties	5,880	1.2 ties
(b) In bank run, washed gravel and cinders	139,215 ties	101,746	1.4 ties
(c) While surfacing	88,893 ties	46,555	1.9 ties
Surfacing Track:			
(a) In rock and cementing gravel ballast	71,870 lin. ft.	18,323	3.9 lin. ft.
(b) In bank run gravel ballast	852,872 lin. ft.	153,221	5.6 lin. ft.
(c) In washed gravel and cinders	724,466 lin. ft.	94,720	7.6 lin. ft.
Dressing Track:			
(a) In rock and cementing gravel ballast	15,386 lin. ft.	1,895	8.1 lin. ft.
(b) In bank run gravel ballast	277,494 lin. ft.	27,225	10.2 lin. ft.
(c) In washed gravel and cinders	165,672 lin. ft.	10,266	16.1 lin. ft.
Unloading and distributing rail and fastenings	211,397 lin. ft. of track	3,369	62.8 lin. ft.
Laying new rails	318,157 lin. ft. of track	52,204	6.1 lin. ft.
Laying second-hand rails	43,417 lin. ft. of track	6,175	7.0 lin. ft.
Uncoupling old rail	106,374 lin. ft. of track	3,014	35.5 lin. ft.
Loading old rail and fastenings	114,263 lin. ft. of track	2,899	39.4 lin. ft.
Applying rail anchors	107,302 anchors	3,445	31.2 anchors
Applying tie plates	201,186 tie plates	11,830	17.0 tie plates

Part 2

This year it was considered to be the duty of the committee to determine upon economic methods of doing particular items of maintenance of way work, such as laying rail, renewing ties, surfacing track, etc.

The committee conceived it to be its duty not to simply secure such data and submit it as information, but to make a thorough analysis of the record submitted by each carrier and determine upon one or more methods of performing specified operations which would be recommended to the association as approved practice.

Conclusions

In making recommendations that the study of this subject be continued next year, the committee submits as sample forms, two studies which are in the approved form, and asks that those two operations, viz.:

(A) Renewing Rail—Out of Face,
(B) Renewing Cross-ties,

be made subject of study and preparation of statements by all members of the association next year.

Two things are vital to the continuance of the investigations of this subject:

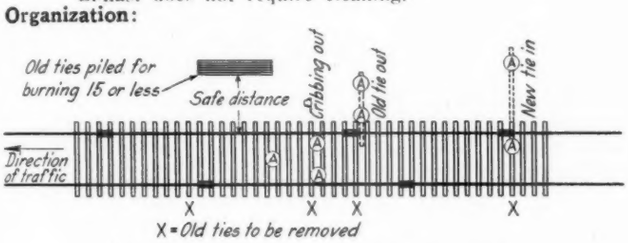
First—Submission of statements of performance by the various members of the association.
Second—Preparations of those statements in uniform manner, conforming as nearly as possible to the sample forms attached

Renewing Cross-Ties

Condition "A" Sheet 1

Single Track or Outside Track.
Track not raised.
Stone Ballast.
Cribs Full
Ballast does not require cleaning.

Organization:



Disposition of a Gang on Tie Renewals

Index Letter	Number of Men	Force
A	6	Men work in pairs completing full operation
X	1	of tie renewal as detailed in Method.
Total	7	

Method.—Before beginning tie renewal the Foreman will go over the new ties marking (1) those ties to be used under joints, (2) which side of tie is to be uppermost, and (3) a line indicating where the outside base of outside rail should come.

One man should be assigned to draw spikes on all ties to be renewed, except that spikes shall not be drawn on more than one of three adjacent ties.

Sufficient ballast should be removed to allow old tie to be readily moved sidewise in crib, then drawn out. The bed is then prepared and the new tie drawn in with tie tongs, after which the tie is held up to the rail and tamped under both faces of the tie to the outer end of the tie and 18 in. inside of the rail. Spiking follows.

Ballast is cleaned if dirty and returned to the crib, and the shoulder dressed.

Renewing Cross-Ties

Condition "A" Sheet 2

Schedule:

Time Distribution—Minutes per Tie

Operation No.	Operation	Minutes per Tie
1	Cribbing out	16
2	Drawing spikes	5
3	Removing old tie	2
4	Preparing new bed	3
5	Carrying tie to place	2
6	Placing new tie	2
7	Applying two tie plates	1
8	Driving four spikes	4
9	Tamping	13
10	Replacing and dressing ballast	10
11	Carrying old tie and piling for burning	2
	Foreman, one-tenth of above time	6
	Total minutes for one tie, cribs full	66
	Standard schedule, hours per tie, cribs full	1.1

Average Performance:

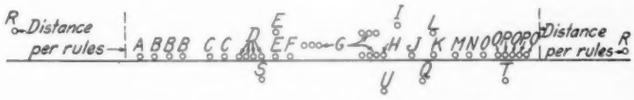
7 men working 8 hours per day.....56 hours
Schedule .....1.1 hours per tie
Detention—Going to and from work and clearing track for passing trains. Allowance being 10 per cent of total actual hours on tie renewals reported for the day..... .10
Actual hours renewing cross-ties—56÷1.10=50.9 hours.
Standard performance per day—50.9÷1.1=46 ties.
Average performance per day, 67%: 46×.67=31ties.

Renewing Rail—Out of Face

Condition.—Single track branch line. Laying rerolled 100-lb. rail weighing 90-lb. per yard in place of 100-lb. rail which had been sawed before laying in branch line track. Rerolled rail in 33-ft. lengths. One-half inch narrower than in sawed rail so that it is necessary to pull outside spikes only.

No tie plates.
Plain 4-hole angle bars on both old and new rail.
No anti-creepers applied.

Organization:



Disposition of a Gang Relaying Rail

Force

Index Letter	Operation	Number of Men
A	Adzing around spikes to be drawn	1
B	Drawing every third spike and starting the remainder of outside spikes	3
C	Pulling remainder of outside spikes	2
D	Throwing out old rail	4
E	Putting in tie plugs	2
F	Adzing	1
G	Setting in new rail	12
H	Placing expansion shims	1
I	Distributing spikes, bolts and nutlocks	1
J	Pulling spikes which would be in the way of new splice	1
K	Holding rail against inside spikes with bar	1
L	Driving two spikes to rail	1
M	Pushing larry car with tools	1
N	Putting on splice	1
O	Putting in and tightening two bolts to the joint	4
P	Spiking every other tie	2
Q	Waterboy	1
R	Flagman	2
S	Foreman	1
T	Assistant foreman	1
U	Timekeeper	1
	Total	44

Method

Traffic in both direction is protected by flag.

An adzman cuts the ties around the spikes which are to be drawn. He is followed by claw-bar men who pull every third spike on the outside of the rail and start the remaining outside spikes. These men continue at this work until they have reached the end of the rail to be relaid for the day.

As soon as it is permitted to break track, two men with claw-bars pull the remaining spike on the outside of the rail. Next, four men with bars line out the old rail. Two men put in tie plugs and one man completes the adzing.

Next, 12 men with rail tongs pick up the new rail which has been distributed outside the ends of the ties and lift it into place over the old rail. One man puts expansion shims between rails as they are being put in place.

One man with a claw bar pulls the inside spikes which will interfere with the placing of the new splice. One man holds the new rail against the inside spikes with a bar while another man drives two spikes to each rail to hold it in place.

One man puts on the splice bars and puts one bolt in each joint without tightening up the nuts. He is followed by four men who put in one additional bolt to each joint and tighten up all bolts put in. Two men follow, spiking every other tie.

After the track is closed the entire gang turns back and full bolts and spikes.

Time Distribution Based on 10 Rails

Operation	Minutes for 10 rails
Adzing around spikes to be drawn	40
Drawing one line of spikes	139
Throwing out old rail	54
Putting in tie plugs	25
Adzing	14
Lifting in new rail	164
Distributing spikes, bolts, and nutlocks	14
Placing expansion shims	15
Pulling inside spikes which would be in way of new splice	15
Holding new rail against outside spikes with a bar	16
Pushing larry car with tools	16
Placing splice bars and full bolting	143
Full spiking	157
Water boy	34
Flagmen	68
Foremen	34
Assistant foreman	34
Timekeeper	34
Uncoupling old rail	72
Total time for 10 rails	1,088
Total minutes for one foot	3.30
Standard schedule hours per 33-ft. rail	1.813

Average Performance

44 men working 10 hours per day ..... 440 hours
Schedule—1.813 hours per rail.
Detention—Making four connections at an allowance for each connection of 1⅓% of total actual hours of rail laying reported for the day ..... .0133×4=.0532
Actual hours applying rail 440÷1.0532=418.
418÷1.813=231 rails.
Average per day, 66% 231×.66=143 rails.

Discussion

C. C. Cook (acting chairman): Some of the committee members feel that we have fully covered the subject of obtaining and retaining railway labor in the general recommendations that were made last year. There is a feeling that by an investigation of outside industries which have adopted definite plans for obtaining and holding their labor we might be able to present something of value to the railroads.

G. D. Brooke (B. & O.): This is such an important subject and such an important assignment that it seems to me the committee should leave nothing undone to obtain all the possible information and place it at the disposal of the railroads.

E. R. Lewis (M. C.): I do not see how we can go any further with the subject or do any good for the association unless we go outside.

R. H. Ford (C. R. I. & P.): There is a feeling on the part of some members of the committee that the railroad field is a peculiar and a definite one, and that no direct, positive benefit would be obtained by a comparison of the methods employed in the industrial field. The other view is that an industry is no different in respect to the subject of labor than a railroad.

J. A. Stocker (T. & O. C.): This one committee deals with matters that affect about fifty per cent of our expenditures. We are now talking about obtaining and retaining labor. I believe every member of this association ought to give this subject more thought than we have been giving it. The time has come when we have got to take some real definite step forward.

Maurice Coburn (Penna.): I have been interested in some of the things that some of the other industries are doing, and I feel there is a need on most railroads of a different attitude and an enlarged viewpoint in connection with the handling of their men.

President Campbell (speaking from the floor): Our road (E. P. & S. W.) lies along the Mexican border for a good part of the way and we have there what we call the native Mexican. We have, in recent years, begun to provide good quarters, and we have taken very good care of the men. As a rule, they appear to be well satisfied and we are getting along, altogether, very comfortably as far as common railway labor is concerned.

As to the other types of labor, we are having no special trouble with that. We provide good buildings for them all along the line. We do not have a large organization devoted to the procuring of labor, as that is not necessary. The means which I have indicated seem to hold our labor very well.

(Willard Beahan (N. Y. C.), after outlining the experience of his road with negro labor, concluded as follows):

You have got to take the help that you have. That is your job and mine. You may not like Mexicans. You may not like negroes. If you work Mexicans, you must work them like Mexicans are working. The labor problem is is one of the principal questions before us today and it is up to the engineers to solve it or fall down.

Mr. Brooke: There is no question about the fact that there are times when we have got to lay off labor. That is a situation that is not peculiar to the railroads. It applies to all industries, and the fact that we have trouble with our labor is not caused by the fact that we have to lay them off from time to time.

W. H. Kirkbride (S. P.): Our main standby is Mexican labor, which we look upon as being very satisfactory. It is remarkable to see and note the evolution which takes place in these Mexicans, particularly on the part of the children. When they are brought across the border they are dirty and unkempt, but very shortly after we take hold of them the improvement in the children is remarkable. The Southern Pacific tries to educate them. We maintain schools, we maintain the best living facilities that we can and we put up our very best bunk houses. I think that is the keynote of the labor situation. We look upon the Mexican with a good deal of hope as a source from which to get section foremen.

The attitude of railroad officers toward their laborers is important. There are a good many of the oldtime men, straw bosses, who are possessed with the idea of bossing labor with a pick handle. That does not go any more.

I think there is going to be a shortage of labor and very high wages in connection with the immense building activities in the United States. However, the railroads have something to offer the mechanic other than high wages, such as permanent employment, the benefit of hospital treatment, passes, and favors of that kind. I think it would be well to encourage those lines of action, offering favors, passes, etc., so as to get men to stay with you once they have been taken into the service of your road.

A. S. Butterworth (G. F. & A.): I feel that the committee should by all means go outside for their information with reference to obtaining and retaining railway labor. It can get a good many excellent ideas in the matter of the best means of handling the labor question from the logging and lumber industries in the country.

(Following this discussion, Mr. Cook submitted the report of the committee as information and the report was accepted by the convention as submitted. The committee on the Economics of Railway Labor was then excused with the thanks of the members of the Association.)

Report on Economics of Railway Operation

The Committee on Economics of Operation went into the subject of operation on a most practical basis and presented a considerable amount of information on methods of increasing the traffic capacity of a railway, the feasibility and economy of through routing of solid trains and its effect upon the capacity of terminals and other features which are full of usable data. It is noted that only a few roads are actually making a practice of through routing trains, but where such has been done considerable reductions in expense have resulted and improvements in service effected. Studies were made for the purpose of establishing the relation between theoretical and actual track capacities. Curves were plotted showing actual road times and the effect of double tracking.

G. D. Brooke
Chairman

G. D. Brooke, superintendent of transportation, Western lines, Baltimore & Ohio, is chairman, having served as vice-chairman during the preceding year and as a member of the committee since 1917. Mr. Brooke has had wide experience in engineering and operating matters, having served in the engineering department of the Baltimore & Ohio from 1902 to 1912, when he entered the operating department as assistant superintendent, where, after holding various positions, he was promoted in 1919 to superintendent of transportation.

THE COMMITTEE PRESENTED its conclusions relating to the study of the effects of speed upon the cost of operation in Appendix B, and the methods of increasing traffic capacity of a railway in Appendix C (as information). Both are given herewith. It also presented detailed data as information in Appendix D, not included here, on Methods for Analyzing Costs for the Solution of Special Problems With Which the Committee is Concerned. The Feasibility and Economy of Through Routing of Solid Trains and its Effect upon the Capacity of Terminals was presented in Appendix E and Methods for the Determination of Proper Allowance for Maintenance of Way Expenses Due to Increased Use and Increased Investment in Appendix G and are given herewith. No definite recommendations were made for inclusion in the Manual, the report being presented simply as information.

Committee: G. D. Brooke (B. & O.), chairman; R. T. Scholes (C. B. & Q.), vice-chairman; E. G. Allen (A. T. & S. F.), W. G. Arn (I. C.), J. B. Babcock (Mass. Inst. of Tech), M. C. Blanchard (A. T. & S. F.), J. M. Brown (C. R. I. & P.), J. W. Burt (C. C. C. & St. L.), B. M. Cheney (C. B. & Q.), M. Coburn (Penna.), E. J. Correll (B. & O.), H. B. Grimshaw (S. A. L.), C. S. Gzowski (C. N. R.), R. B. Jones (C. P. R.), E. T. Howson (*Railway Age*), E. E. Kimball (General Elec. Co.), F. H. McGuigan, Jr. (U. S. R. A.), F. G. Nicholson (C. & E. I.), A. H. Ostberg (C. B. & Q.), J. F. Pringle (G. T.), H. T. Porter (B. & L. E.), Dean W. G. Raymond (Armour Inst. of Tech.), H. A. Roberts (O. W. R. & N.), L. S. Rose (C. C. C. & St. L.), Mott Sawyer (C. M. & St. P.), D. L. Sommerville (N. Y. C.), J. E. Teal (B. & O.), H. M. Tremaine (Pres. Conf. Com.), F. H. Watts, (Penna.), B. Wheelwright (G. T.), J. L. Wilkes (Jacksonville Term.), C. C. Williams (U. of Ill.), R. C. White (M. P.), Louis Yager (N. P.).

Appendix B—Effects of Speed Upon the Cost of Operation

It was the conclusion of the committee that further data on the effect of speed of trains on the cost of maintenance of way and maintenance of equipment which will justify modification of its former reports on these subjects are not available, and although the speed of trains unquestionably does have a direct bearing on these costs, the speeds of trains under actual operating conditions are fixed by the requirements of the traffic and service and by their relation to the cost of transportation so that the effects of speed on maintenance of way and maintenance of equipment become of relatively minor importance and are necessarily neglected in reaching conclusions in the determination of such speeds. The sub-committee has learned only recently of certain tests made on the Illinois Central and on certain other roads to determine the effect of variation in load and resulting variation in speed on the cost of transportation. For the next year's work, therefore, it was recommended that the instructions embrace only the effect of speed on cost of transportation.

Appendix C—Methods of Increasing the Traffic Capacity of a Railway

The effect of three fundamental conditions upon train performance was developed in last year's study. These conditions were: Length of division or engine district, number of trains, and speed of trains. The mathematical formulas developed for these conditions are valuable in establishing the effect of other conditions on train operations. Some difficulty is being experienced in applying the formulas to practical problems for the reason that in most cases where the necessary operating data can be obtained the conditions are not as simple as could be desired.

The section of road selected for this year's study has a good many irregularities of a nature we are not prepared to correct for in testing the mathematical formulas, and the conclusions which can be drawn from the discussions are tentative. This engine district is approximately 140 miles long and contains two single, and two double track sections. It was selected because the character of the service was unlike that of the engine districts studied last year. Data was collected to compare the operation of the double track sections with that of the single track sections; the operation of one double track section with another double track section, and likewise, a single track section with another single track section. With this data it was expected to show that if there were two single track sections of the same character, it would be possible to calculate a theoretical train-hour diagram for one section from the theoretical train-hour diagram of the other, using the formulas developed last year. This theoretical train-hour diagram would have the same factors as the one calculated from the actual train-hour diagram. Likewise, the same thing would be true of the double track sections. On this basis a double track section would be used to forecast what the operation of a single track section would be after it was double tracked. Then from the equations of the theoretical train-hour diagrams the average running time, or the average road time for various numbers of trains could be calculated and plotted. The solid lines represent the average road time eastbound and westbound on single track with existing sidings and the dotted lines the aver-

age road time if the section were double tracked or if the same facilities for the double track section were extended to include the single track section.

The horizontal distance between the two lines represents the gain in time by the operation of a double track in place of a single track, and the vertical distances represent the gain in capacity by double tracking for the same road time. It will be seen that the capacity has been increased more than double, but the amount of track added is more than double the total length of passing sidings now installed. It would be expected that this would be the case so that the next step is to find a relation between the increase in capacity and the amount of track added.

Data is now being studied which it is hoped will indicate what this relationship is. The study of this data could not be completed in time to appear in the bulletin, but it will be ready to present before the convention in the form of a discussion of the report.

The curves in Fig. 1 have been worked up from data obtained from two sections. These two sections came the nearest to being similar sections, that is, their profiles were more nearly the same than those of any of the other sections. However, the grades against the heavy eastbound trains are more severe on the single track section than on the double track section; therefore, it is possible that part of the slower road time on the single track section may be due to the heavier grades and consequently all the gain in capacity and road time may not actually be obtained by double tracking.

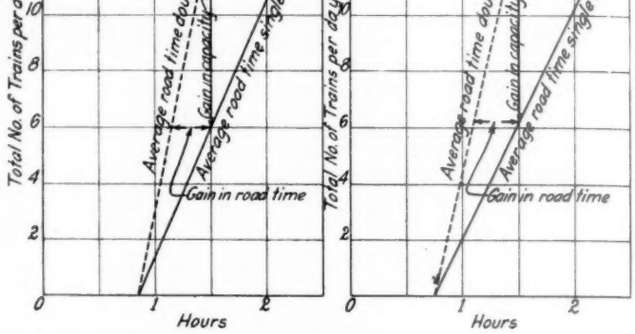
Attention is called to the train-hour diagram for the double-track section. It appears that the delay time, the area between the "road time" and "running time" curves is very large for a double track section. This is explained by the fact that all freight trains stop at station "A" for coal and water and at this point a large number of trains reduced tonnage eastbound and filled out westbound. The total average delay between Stations F. and L. was 73 min. eastbound and 77 min. westbound. Of these amounts the total average delay at Station A was 51 min. or 70 per cent of the total delay eastbound and 42 min. or 55 per cent westbound.

In order to make the report more valuable in case other examples are presented, attention is called to the existence of operating conditions on this line which may not be found on other lines.

Finally, if a sufficient number of cases are studied, so as to segregate the various conditions, there is a possibility that use can be made of the mathematical theory.

One of the figures shows the profile and track chart of the engine district used for this study, together with train-hour diagrams illustrating freight train performance over the various single and double track sections for 21 days' operation in April, 1922. During this period about as many passenger trains as freight trains were operated. Train-hour diagrams of the passenger trains have not been constructed, for the reason that those trains are all scheduled, and it can be assumed that they ran very close to their schedules. It is a fact, however, that passenger trains do interfere with the operation of freight trains, the extent of this interference depending upon the number of passenger trains operated, and the relative speeds of the two classes of service. By the way of suggestion it may be possible that the effect of passenger train upon freight train operation can be closely estimated by comparing this study with studies of other roads having fewer passenger trains but otherwise about the same character of freight service.

The theoretical train-hour diagrams, shown in the figure, for the most part follow the actual curves for "running time" very closely, notwithstanding the fact that the data covers both fast and slow freight trains. In the case of the curves for "road time" the agreement between the theoretical and actual curves is not so close, which no doubt is due to the distortion caused by the operation of both classes of freight trains. The fast freight trains having preference over the slow freight trains received the benefit of shorter delays at meeting points, whereas the slow freight trains are handicapped for the same reason. The result is a flattening out of the "road time" curve, causing the theoretical "road time" and "running time" curves to cross. This is a condition which is not



Showing Effect of Double Tracking Upon Average Road Time

consistent with the facts and to overcome this objection to the formulas it is either necessary to make separate curves for the fast and slow freight trains, or to use a modification of the method for obtaining the equation of the theoretical "road time" curve.

The method suggested for correcting for the inconsistency of the theoretical curves for "running time" and "road time" crossing is to calculate the equation for the theoretical road time from the total area (total road time).

$$\text{Thus total hours} = N\left(t_o + \frac{\sqrt{\pi}}{2n}\right)$$

By assuming t_o for the road time equal to or greater than t_o for the running time a value of n will be found which will give a curve which more or less corrects for the distortion caused by considering both classes of freight trains together.

It is desirable to segregate the trains that make the entire run from those that make only partial or turn around runs. In this case less than 10 per cent of the runs were of a miscellaneous character. Ordinarily they would be neglected, but if they constituted a considerable portion of the service they would have to be taken into consideration.

In addition to the customary curves showing "running time," "road time," "elapsed time," and train weights, the fast freight trains are distinguished from the slow freight trains, the two engine trains from the single engine trains, and the class of power in service is also indicated. Train performances mean little, unless the tonnage rating or characteristics of the class of power in service are also given.

Appendix E—Feasibility and Economy of Through Routing of Solid Trains and its Effect Upon the Capacity of Terminals

While the practice has prevailed generally of making up trains only for the next terminal, the grouping of

cars for remote points into solid trains for movement intact through intermediate terminals is not new. It was one of the fundamental principles of operation of James J. Hill and was put in effect for transcontinental traffic on the Great Northern and the North Pacific more than twenty years ago. It has also been practiced in the handling of fruit, meat, live stock and other business requiring special movement. However, until the last three or four years the possibility of applying this practice to all classes of traffic between all points has not been realized. One of the earliest roads to apply it universally was the Baltimore & Ohio, where it was made effective on the Eastern Lines in 1919 and was extended over the entire system the following year. It was introduced generally on the Missouri Pacific approximately two years ago, on the Chicago, Burlington & Quincy a few months later, and on the Grand Trunk during the past summer.

As it has probably been developed more thoroughly on the Baltimore & Ohio than on other roads, specific mention will be made of the practice in vogue there. Prior to the inauguration of this system a detailed study was made of all of the traffic moving over every portion of this road and of the terminal facilities available for its classification. A book of instruction and standard practices was then prepared showing in minute detail where and how all trains should be made up and classified so as to move each car with a minimum of switching between origin and destination, while providing that this work should be done at those points on the line where the facilities are most adequate for the particular requirements. Trains are classified completely as near the origin of the traffic as possible in such a way that they may be run through as many terminals as possible without break-up. In the actual working out of this system approximately one-third of all trains entering the terminals over the system are forwarded without break-up. Indicative of the reduction effected in the amount of switching a saving of 61,167 engine hours was made during the month of June, 1921, as compared with June, 1920.

The folowing quotation from the reply to a questionnaire indicates the experience of the Chicago, Burlington & Quincy:

"We have specialized on the grouping of trains operating on through intercity schedules, because we found that our service could be improved materially if we could reduce the yard and road delays incident to switching or setting out and picking up of cars.

"We have been successful to the extent of quickening our destination deliveries 24 hours in some cases, and at the same time have added to the gross tonnage of trains. Such trains have been able to move with sufficient regularity to enable connecting divisions to order power and crews in advance of the arrival of the train. Therefore they have been subject to only such delay as is incident to changing engines and way cars. If there are cars to come off at any particular terminal they are placed in the train either just behind the engine or next ahead of the way car, so that only one operation is necessary in taking off the cars.

"In connection with trains handling general freight, such as coal, we have been successful in operating solid trains, as, for instance, between Centralia, Illinois, and Chicago, without any switching at the two intermediate yards other than to set out such cars as many require repairs. On our Denver schedules we

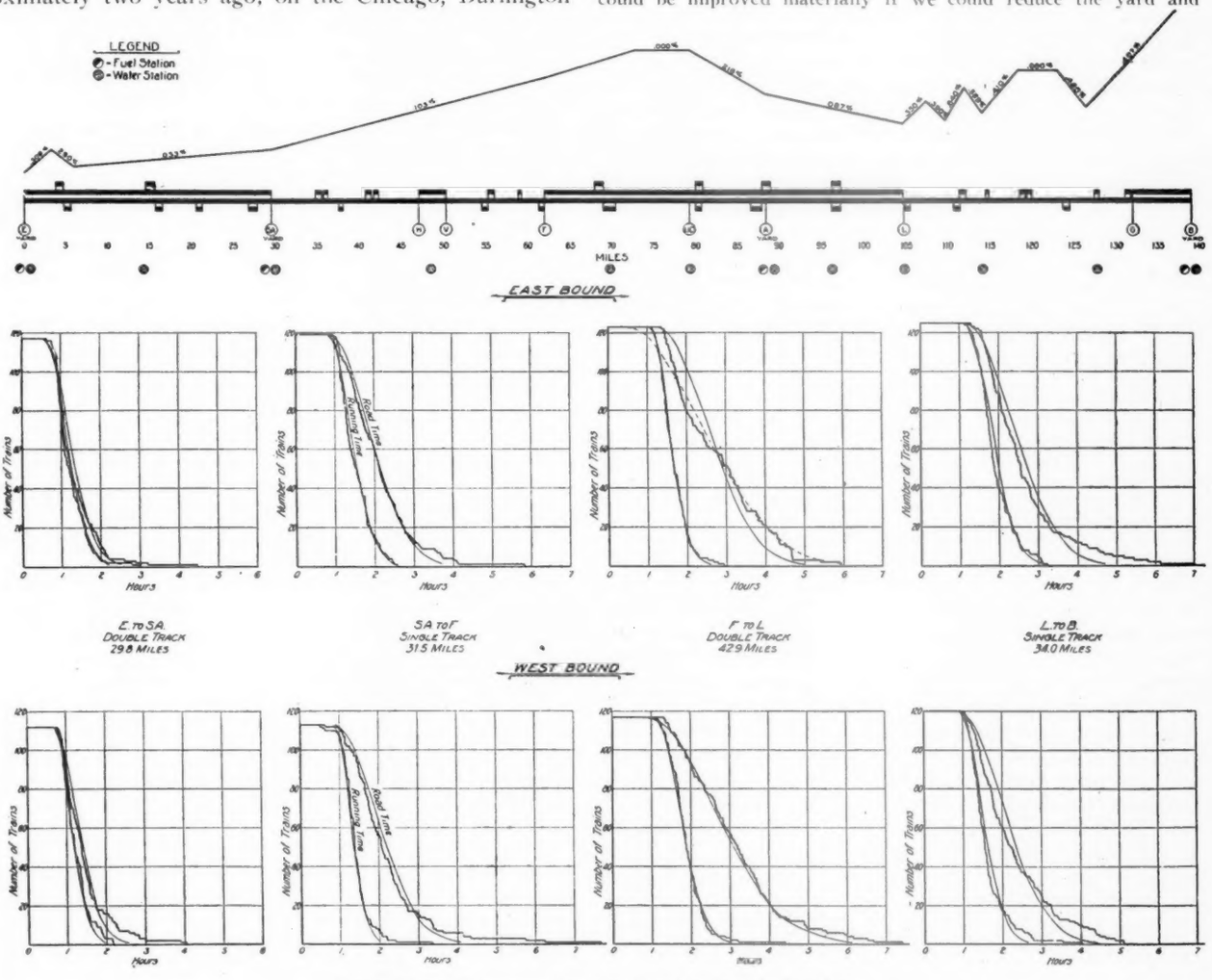


Fig. 2.

Train Hour Diagram for the Double Track Section

operate through eight terminals without changing the interior of the train. We may take off or add tonnage on the head end or rear end as a fill-out, but the interior of the train is not touched, and on that particular schedule we have been able to make fourth morning delivery at Denver instead of fifth, although the actual shortening of the schedule is but ten hours and thirty minutes.

"We have been able, through the grouping plan, to reduce the number of switch engines operated perhaps to the extent of 50 or 60 eight-hour tricks throughout our railroad. Not only that, but we have reduced the number of cars involved in the terminals by reducing the inspection of these through trains, having them run through two or three terminals before they receive what we call Class A inspection.

"In quickening the movement of all trains several hours there is a large saving in the aggregate in overhead per diem, which, together with economies effected in yard operation, enable us to show a saving of perhaps one and one-half million dollars in the first calendar year the system was in effect."

While it is evident that holding of cars in the initial terminal a sufficient length of time to enable a solid train to be accumulated for a remote point results in an initial delay and increases the amount of switching at this terminal somewhat, the replies to the questionnaire indicate that this additional delay and expense are more than outweighed by the savings made at intermediate terminals.

We believe that this subject warrants more careful investigation than it has received from most railways, particularly with reference to its adaptation to the general run of traffic. We believe that it offers marked opportunities for the reduction of expense for freight classification and damage to equipment and lading resulting from switching as well as the improvement in service resulting from the speeding up in movement.

Appendix F—Method for the Determination of Proper Allowances for Maintenance of Way Expenses Due to Increased Use and Increased Investment

Section I—Allowance for Increased Use

The assignment has been studied jointly with a subcommittee of the Committee on Records and Accounts. A review has been made of previous work in this field, such as rate litigations, statistical comparisons of the relative performances of different railroad properties, studies of railroads of their own properties for various economic comparisons, federal control developments, etc.

An ideal comprehensive solution of the problem should result in the determination of the relation between physical maintenance and production of transportation units by a property in its local conditions of geography, standards, management and earning capacity; a determination analogous to that of relation of the upkeep requirements of an industrial plant to its output. It further presupposes the desirability of knowing the absolute effect of "use" or production of transportation units upon each account in the maintenance classification; a knowledge obviously beyond the economical or practical limits of physical records and accounting data.

The problem is particularly complicated for immediate current comparisons by the fact that maintenance may be deferred or stored up in excess of immediate requirements to be dissipated at some future date. There is not that direct, obvious relation between cause and effect that seems to obtain in transportation expense. Any rational solution of the problem requires a reasonable determination of the effect upon the property units regardless of when or how the resulting maintenance requirement may be provided.

A consistent and well-balanced maintenance of any property ultimately requires a proper relation of expenditures on the various units of property for the production of transportation units. Situations arise, however, when, for certain periods, expenditures are not or cannot be provided in accordance with that relation, but during a suitable interval sufficiently extended to include the cycle of major material renewals, the general averager of maintenance conditions may be consistently maintained. A substitution of labor for material is an expedient sometimes resorted to in order to maintain satisfactory conditions temporarily, and from the standpoint of total expenditures may create the impression that adequate maintenance has been provided. In making comparisons for any periods of time, it is necessary that due recognition be given to changes in the relation between labor and material applications which may have altered the physical trend of property condition.

The solution of our problem must lie along the lines of adapting accounting records and maintenance judgment to a correct appraisal of the influence of "use" on maintenance necessities. A promising method which appears to give results within limits sufficiently accurate for practical purposes in studying properties as a whole or in detail is based on a segregation of the maintenance necessitated by the existence of the property and the use made of it. The principles of this method, in some more or less complete form, have previously been used in comparisons of properties or past performances as well as having been used in the special conditions created during the period of federal control. A review of this general method constitutes the progress report of the committee's efforts to date. A consideration of this method requires the discussion of:

I—The "Use" Unit.
II—The Influence of "Use" on Maintenance Accounts.
III—The Maintenance Unit.
IV—The Solution of a Problem.

I—The "Use" Unit

In general, every railroad produces transportation units in the two quite distinct classes of freight and passenger service. Since no common transportation unit can adequately cover both, it is necessary to combine and measure the effect through a suitable equated unit.

The "Use" Unit should be related in some definite way to the two classes of traffic, which are in general distinguished by the two principal characteristics of weight and speed, which directly influence maintenance requirements. The following transportation units, train miles, engine miles, net ton miles, gross ton miles, car miles, engine ton miles, and locomotive tractor power miles, have been used to a greater or less extent as measures of use, but these are inadequate because they are singly not sufficiently inclusive to cover the normal variations in traffic.

Every ton of locomotives, cars, and their contained loads, makes an impression in some quite distant manner upon the physical property over which it is moved. It is an acknowledged fact that a ton of locomotive passing has a relatively greater effect than a ton of cars; and likewise the greater the speed of locomotives and cars, the greater the destructive effect. Freight service and passenger service are distinguished by a difference in average speed of movement. There are, of course, portions of each service which approach each other in characteristics of weight and speed, nevertheless these two are, in general average, separated by differences in speed.

There seems to be good reason for selecting the freight gross ton as the basis in the equation scheme on account of its general advisability, its relatively large proportion of the weight element on most railroads, and the further general similiarity of gross tons. Gross tons of freight cars are, therefore, taken as unity; freight-locomotive-tons are given a factor of two; the passenger-locomotive-tons a factor of three; and passenger-car-tons, a factor of one. The factor of one for passenger-car-tons

is in recognition of the fact that higher standards of equipment construction, and the better maintenance of passenger equipment over that of the freight cars, tends to mitigate the damage resulting from a higher speed, as well as the special requirements demanded thereby.

Passenger service requires, or at any rate dictates, a higher standard than is required for exclusive freight service. This in turn necessitates more immediate reparation in wear and tear. The existence of a higher standard automatically operates to reduce the wear and tear from the co-existent freight service. Various attempts have been made, without convincing success, to actually measure the difference in reparation attributable to freight and passenger service. The difficulties of measurement are due to the limitations of accounting records, and the long interval of time required to include the cycles of major material renewals, as well as the determining of the relative maintenance standards.

Trials which have been made from time to time on various typical railroads indicate that the allocation of "use" units as between freight and passenger service, based on the equated plan outlined, over any considerable period, seem to give a reasonable expression of the maintenance that should be charged against these two services, at least within limits of accuracy consistent with the practical application of such a method, and the confirmation of the best maintenance judgment available for these properties. It is recognized, of course, that there are some outstanding exceptions such as properties on which the performance of fast freight movement is high, or is increasing out of proportion to the other tonnage movement. These cases require a special treatment in accord with the principles suggested.

II—The Influence of "Use" on Different Maintenance Accounts

There are three classifications of accounts in their relation to "use":

(1) Those varying directly with use,
(2) Those varying independent of use,
(3) Those varying with combined effect of use and other agencies such as weather stress.

The effect of "use" on (1) is absolute, on (2) is zero, and on (3) is fairly determinable by a study of data checked by experienced maintenance judgment.

In the case of roads with light or moderate traffic density and corresponding roadway standards, increases in traffic make themselves immediately evident and require more prompt liquidation in the expenditures for labor to restore condition of line, surface, etc., than on roads of hgher standards where the damage may be largely accrued. Wherever there has been a temporary lowering of physical standard due to deferred application of material, a compensation must be made, at least temporarily, by larger expeditures for labor than would otherwise be normal in the effort to maintain a reasonable standard of line and surface.

As an illustration of the general application of this method resort is had to the use of a readily available I. C. C. record of M. W. & S. expenses for all Class 1 carriers for the three-year period ending June 30th, 1917. In the table, Column (3), gave the percentage which each account is of the whole M. W. & S. Expenditures. In Column (4) was outlined the percentage which each account is affected by "Use." These percentages are average values, consistent with the average conditions and performances of the carriers included in the statement. These percentages may be varied to suit the circumstances of each particular problem.

Recapitulation of Items A. & B. Track material—Principal labor items, etc., 72.98, 40.38, 29.47.

By the assumptions of this method, an increase of 100 per cent in traffic would result in a potential maintenance expense increase of 33.13 per cent.

A period is selected as the base period and "use" during this period is compared with that of a period under question, which is called the comparison period. The resulting ratio is multiplied by 33.13, the percentage of the total M. W. & S. expense affected by "use" (or any other percentage that may result from the analysis of any particular situation) to obtain the percentage of increase or decrease in maintenance requirements due to the difference in "use" during the two periods.

III—The Maintenance Unit

There must be a maintenance unit closely related to the use unit for making comparisons. From the above analysis of maintenance accounts it is apparent that the track material and principal labor items related thereto, amounting to about 73 per cent of the total expenses, absorb 88.95 per cent of the total effect of use on M. W. & S. expenses, so that a track unit would be the most inclusive related property unit to use.

Maintained mileage will adequately serve the purpose in comparisons for different periods of time during which there has been no material change in the relative influence of use as between primary and secondary tracks. In the event of such changes, a refinement should be introduced by using a suitable equated track mile to express at least an approximate relation of maintenance necessity as between the different classes of tracks.

IV—The Solution of a Problem

The segregation of use effect on the individual maintenance accounts permits the treatment of each in line with special situations which may vary from the average. Comparisons may be made as outlined for different periods of time for a property as a whole, or sub-divisions for which comparative data may be made available.

This method determines the potential maintenance requirement caused by a use of the property regardless of whether the same has been met, so that in making comparisons for any period, it is essential to determine the normal maintenance incident to the peculiar condition of the property by taking into account any deferment or appreciation of maintenance. It is understood that in using expenditures for comparison periods the accounts will be examined for any adjustments which would prevent their reflecting maintenance performance.

Comparisons as between different properties or different sub-divisions of the same property can be made by adjustments for the standards or conditions which account for the dissimilarities.

Maintenance reparation is composed of properly related material and labor units ultimately expressed in total money expenditures, so that for comparisons it is necessary to equate the costs correspondingly.

$$\text{Difference in "use" expressed by: } \frac{\text{Average units of use per maintained equated track mile for Comparison Period.}}{\text{Average units of use per maintained equated track mile for Base Period.}} =$$

$$\frac{\text{Equated gross ton mile per maintained equated track mile — Comparison Period.}}{\text{Equated gross ton mile per maintained equated track mile—Base Period.}} = \text{say } \frac{5{,}200{,}000 \text{ equated gross tons}}{4{,}000{,}000 \text{ equated gross tons}} = 1.3$$

Therefore 30 per cent increase is indicated.

Effect of Increased "Use"=.3313 x 30=9.94 per cent increase in maintenance necessity over the Base Period.

In using this method, allowance must be made for increased property units or investment outlined below:

SECTION II—ALLOWANCE FOR INCREASED INVESTMENT

This problem is complicated by the inclusive character of Increased Investments, which cover units of property in nowise similar in their maintenance requirements, so that a common unit of comparison is not available. Since maintenance and accounting science has not developed to the point where the effect of use can be determined in absolute values on the various units of property, and the service life of temporary and so-called permanent structures is not definitely established for the varying conditions, it will be necessary to resort to a method of approximation which conceivably gives results consistent with the usual requirements of these comparisons. In line with such a plan, the "Increased Investments" may be divided into the following general classes:

A. Investments relating directly to roadbed and track items.
B. Investments concerned with the general grouping of structures.
C. Investments in betterments.

A.—INVESTMENTS.—ROADBED AND TRACK ITEMS

From the discussion in Section I it is evident that these items of property stand out prominently in their maintenance requirements and it is also true that they include by far the larger proportion of investments for increases in the railroad plant both for extensions of road and increases in capacity of existing property.

It is likewise obvious that the properly equated track mile is the most suitable property unit for expressing additional maintenance necessity When the data is available, the equated track mile scheme may be extended to include less important track items and thus tend to develop more accurate results.

An illustration of this plan with factors sometimes used follows:

A mile of first main track to be given a weight of 1.00.
A mile of other main track to be given a weight of 0.80.
A mile of secondary main track to be given a weight of 0.50.

The above weighing applied to a concrete example produces the following:

NORTH AND SOUTH RAILROAD

Miles Maintained	*Period for which allowance is to be made*	*Period used as standard or base*
(a) First main track	500 miles	475 miles
(b) Other main track	150 miles	140 miles
(c) Secondary tracks	75 miles	65 miles
Equated Miles Maintained		
(d) First main track (Item (a) x 1.0)	500 miles	475 miles
(e) Other main track (Item (b) x 0.8)	120 miles	112 miles
(f) Secondary tracks (Item (c) x 0.5)	37.50 miles	32.50 miles
Total	657.50 miles	619.50 miles

$$\text{Factor of Increase } \frac{657.50}{619.50} = 1.061$$

Assuming the maintenance expenses for the Roadbed and Track accounts of the North and South Railroad for the "Period used as a standard or base" amounted to $500,000, the allowance for the "Period for which allowance is to be made" would be $500,000 by 1.061 or $530,500. This result would apply in cases where the cost of labor and material are the same in both periods. If, however, there was a material change in these costs, adjustments should be made accordingly as outlined in Section I.

B—INVESTMENTS.—STRUCTURES

The accounts in this group are of such a nature that a physical comparison is rendered practically impossible. It has been suggested that a fair unit of measure could be established by applying the cost of maintaining a dollar's worth of property to the difference in the amount of property maintained, as indicated by the Investment Accounts of the two periods under consideration.

This basis might hold on a newly constructed railroad, but has many disadvantages when applied to the older roads. There are very few carriers whose investment accounts reflect the true cost of the physical property and practically no railroad has an accurate division of its "Investment in Road" account between the primary accounts. This is particularly true in cases where roads have passed through receivership and have been sold for fixed amounts. Furthermore, the investment accounts generally do not include any properties which, when constructed, were paid for out of Operating Expenses or Income. There are also many other analogous items which make it impossible to use Investment Accounts for the purpose of accurately measuring the difference in amount of property.

In view of the foregoing, it is our recommendation that the estimated cost of reproduction new, as indicated in the underlying Engineering Reports of the Interstate Commerce Commission, prepared in connection with the Federal Valuation, be used for this purpose in lieu of the so-called Investment Account. Although the inventories vary with the valuation dates of respective carriers, these reproduction estimates are in all cases priced as of 1914.

Before attempting to use these estimates, it would be necessary to pro rate engineering and general expenditures applicable to the various road accounts, exclusive of land, in the same proportion that each account bears to the total, exclusive of engineering and land.

The next step would be to adjust this cost of reproduction by adding thereto all additions and betterments, and deletions. In doing this, unit prices corresponding to those found in the reproduction estimate should be used in order to put all the property on a comparable basis.

By applying the foregoing adjustments, the aggregate amount of physical property, priced as of 1914, can be determined as of any given date.

Having established this adjusted reproduction cost, the next step would be to determine the ratios between each primary investment account, as near as may be, and the corresponding maintenance account. It is here likewise necessary to determine a normal maintenance performance for the base period of comparison. Adjustments should also be made to cover differences in cost of labor and material for the two periods. These ratios having been established, should be applied as follows:

The additions, betterments, and deletions made to the property during the comparison period should be set out by primary accounts, and priced as of 1914. To the net amounts thus derived, the ratios described in the preceding paragraph should be applied, thus establishing, by primary accounts, the amounts necessary to maintain the added property.

C—INVESTMENTS.—BETTERMENTS

The fact is recognized that certain kinds of betterments are installed for the purpose of reducing maintenance costs. On the contrary, there are other types of betterments provided for the purpose of facilitating operation and in many cases increase maintenance costs. The fact that betterments for the purpose of decreasing maintenance costs are included in the two groups of Roadbed, Track and Structures Investments, tends to decrease the accuracy of comparison methods outlined. It is contended, however, that these two types of betterments to a certain extent equalize and that they are relatively a small percentage of the total involved so that no deviation

from this plan is necessary for minor cases. Where an intensive betterment program is involved it will be necessary to make a segregation of these items and adjust the maintenance necessities on the basis of the relation between maintenance requirements of the betterments, and the items which they replaced. It is probable that a further study of this phase of the subject will develop a more comprehensive method of treating betterments in their ultimate influence on the property maintenance as a whole.

General

There will be cases of comparisons which involve both Increased Investment and Increased Use. The allowance for Increased Investment should first be determined as outlined in Section II, followed by the analysis for Increased Use, as indicated in Section I, using the same intensity of use for the units of property in both periods.

Maintenance of Way and Structure Accounts	Account No.	Per Cent of Total M. W. & S. Expense	Per Cent Affected by Use	Per Cent of Total M. W. & S. Expense Affected by Use
	(2)	(3)	(4)	(5)
1. Superintendence	201	5.69	20	1.14
2. Ties	212	15.41	30	4.62
3. Rails	214	2.99	100	2.99
4. Other Track Material	216	4.52	100	4.52
5. Ballast	218	1.88	80	1.50
6. Roadway Maintenance	202	10.96	...	...
7. Tracklaying and Surfacing	220	25.91	55	14.25
8. Roadway Fences	221	.87	...	...
9. Snow, Sand Fences, etc	223	.11	...	...
10. Crossings and Signs	225	1.30	...	...
11. Roadway Machines	269	.45	...	...
12. Small Tools and Supplies	271	1.13	40	.45
13. Removing Snow, Ice, etc	272	1.76	...	...
14. Bridges, Trestles and Culverts	208	7.38	10	.74
15. Tunnels and Subways	206	.32	10	.03
16. Elevated Structures	210	.01	...	...
17. Stations and Office Buildings	227	3.93	...	...
18. Roadway Buildings	229	.53	...	...
19. Water Stations	231	1.31	10	.13
20. Fuel Stations	233	.53	15	.08
21. Shops, Enginehouses	235	2.45	10	.25
22. Grain Elevators	237	.06	...	...
23. Storage Warehouses	239	.01	...	...
24. Wharves and Docks	241	.61	10	.06
25. Coal and Ore Wharves	243	.55	10	.06
26. Gas Power Plants	245	.01	...	...
27. Power Plant Buildings	253	.07	...	...
28. Power Substation Buildings	255	.01	...	...
29. Miscellaneous Structures	265	.01	...	...
30. Underground Power Tubes	204	*	...	...
31. Power Plant, Dams and Pipe Lines	251	*	...	...
32. Power Transmission System	257	.03	...	...
33. Power Distribution System	259	.25	...	...
34. Power Line, Poles and Fixtures	261	.03	...	...
35. Underground Conduits	263	...	...	...
36. Telegraph and Telephone Lines	247	1.11	...	...
37. Signals and Interlockers	249	2.67	30	.80
38. Shop Machinery	302	2.76	40	1.10
39. Power Plant Machinery	304	.44	5	.02
40. Power Substation Apparatus	306	.03	...	...
41. Paving	267	.05	...	...
42. Assessments Public Improvements	273	.07	...	...
43. Injuries to Persons	274	.73	50	.37
44. Insurance	275	.61	...	...
45. Stationery and Printing	276	.20	10	.02
46. Other Expenses	277	.17	...	...
Totals	...	100.00	...	33.13

*Less than .01 per cent.

SUMMARY

Maintenance of Way and Structure Accounts	Per Cent of Total M.W.& S. Expense	Per Cent Affected by Use	Per Cent of Total M.W.& S. Expense Affected by Use
A. Track Material1 Items, 212-214-216-218	24.80	54.90	13.63
B. Roadway and Track, Principal Labor Items, 202-220-221-223-225-269-271-272	48.18	32.87	15.84
C. Structures, 208-206-210-227-229-231-233-235-237-239-241-243-245-253-255-265	17.87	7.55	1.35
D. Wire Lines, Signals and Interlocking, 247-249	3.78	21.16	.80
E. Maintenance of Equipment, Plant Maintenance, 302-304-306	3.23	34.67	1.12
F. Power Facilities, 204-251-257-259-261-263	.31	....	....
G. Miscellaneous, 267-273-274-275-276-277	1.83	46.92	.39
Grand Totals	100.00	....	33.13

Discussion

(G. D. Brooke, chairman, introduced the report and asked the sub-committee chairmen to present the various sub-reports.)

L. S. Rose (C. C. C. & St. L.): Last year this sub-committee presented a report showing the results of a study to increase the traffic capacity of a single-track line. This year, in order to confirm its belief, the committee took another section of line, 140 miles in length, and made a complete analysis of the train operation for a period of 21 days. The results of the study indicated that there were features that the committee could not include in the formula at this time, and it presents the results of that study as a progress report.

The President: If there is no objection, this report will be included in the proceedings as information.

(The next subject, methods of analysis costs for the solution of special problems, was presented by J. E. Teal [B. & O.] and accepted as information. This report was followed by the sub-committee's report on the feasibility and economy of through routing of solid trains and its effects upon the capacity of terminals, which was presented by E. T. Howson, *Railway Age*, and accepted by the association as a progress report. The remaining subject, method for the determination of proper allowances for maintenance of way expenses due to increased use and increased investment, was presented by Louis Yager [N. P.], chairman of the sub-committee. The report was received as information.)

R. H. Ford (C. R. I. & P.): I would like to ask if any application has been made of any part of the work of the committee on any road. For example, every railroad in this country, or a very large part of the railroads in this country, are maintaining their railroads on some method of allowance for the maintenance during the monthly period, and my information is that there is about as wide a variety of methods as there are railroads.

Mr. Yager: That is clearly the ultimate object of this study. The difficulty lies in the fact that we have to adopt some quick and ready method of determining what that method is, and that is the function of the Committee on Records and Accounts, in assisting us. We hope they can develop some ready means to indicate this method of use so as to make the whole method valuable in current allowances for labor.

C. C. Cook (B. & O.): During the negotiations with the government, there was a committee doing work for the corporate engineers that came to a conclusion that supported the conclusions of this committee, i. e., that one-third of the maintenance expenses are affected by change in use.

John R. Leighty (Pres. Conf. Com.): I had something to do with the development of that same subject, which led to a committee which made investigations along this line. We found about 33 per cent being influenced by use and 66 per cent not, which I think was first arrived at by Wellington. Now, manifestly, there is no fixed percentage that will apply under all circumstances. The one-third, two-thirds division seems to be very close to the truth, yet the fact that no one percentage was applicable under all conditions is probably the reason the committee had to break down these expenses and go into more details. But in order to check the accuracy of the one-third, two-thirds division I took a group of 14 railroads, which I considered to be fairly representative, and the composite experience of which would represent an average experience. I took the maintenance of way and structures experience for five years as a basis, assuming that the five years' experience of 14 railroads would represent fairly well a proper expenditure. Then I made an adjustment for difference in the amount of use on this one-third, two-thirds basis, using approximately the unit used which the committee has suggested; adjusting for a difference in amount of property on a basis somewhat in line with that which the committee has used, except that is was a little more subdivided.

Taking into account those changes, I estimated what the expenditures of this same group of roads should have been in the succeeding five years, using the five years' expenditure as a basis, and compared with the next ensuing five years, to determine an allowance. When I checked the determination of allowances in that way against the actual expenditures for the five-year period, the expenditures were 98.5 per cent of the allowance figured according to the formula, which is substantially the same as this committee is using. It was so close it was uncanny.

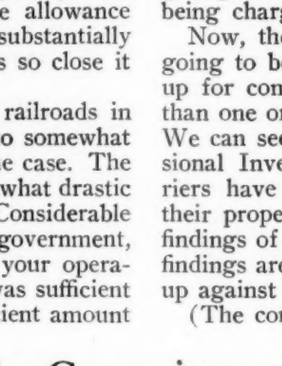
The tightening of the regulations of the railroads in the country has forced railroad operation into somewhat of a more scientific scrutiny than had been the case. The provisions of the Transportation Act are somewhat drastic as to economic efficiency and operation. Considerable money belongs either to the carrier or to the government, depending on your being able to show that your operation, through which the money was earned, was sufficient and was economic, or whether or not a sufficient amount of money has been charged for a year's operation to cover the actual expenses of the year. Take the year 1922, for instance, when railroads were all deferring expenditures. The charges on the books of the carriers did not represent the cost to the carriers for producing transportation. As a matter of fact, the carriers were giving to the public a considerable amount that was not being charged.

Now, the work that this committee is engaged in is going to be very important when those questions come up for consideration, as we hope they will, when more than one or two railroads earn above the allowed return. We can see here some good ammunition for a Congressional Investigating Committee, to show that the carriers have been efficiently and economically operating their property. Unless the carriers generally adopt the findings of this association, or are able to prove that the findings are not what they should be, we are going to be up against that.

(The committee was then excused.)

Report of the Committee on Roadway

The Committee on Roadway presented reports on two of the subjects assigned to it, namely, the chemical killing of weeds and the use of corrugated metal pipe for culverts, but in neither case did it offer definite conclusions for adoption by the Association. In the opinion of the committee, more data must be developed before this can be done. It did, however, state in regard to chemical weed killing that while the experiments have not been entirely satisfactory in some cases, where the application has been made properly the results are generally satisfactory and there is no damage to the metal portion of the road or the track. The committee expects to have a set of specifications on corrugated metal pipe ready for submission at the next meeting.



C. M. McVay
Chairman

The appointment of C. M. McVay, division engineer, New York Central Lines, Charleston, W. Va., as chairman, is of advantage to the committee since he has had a long experience in the problems with which the committee deals. Mr. McVay was engineer maintenance of way of the Kanawha & Michigan before it became a part of the New York Central Lines and has since retained the same jurisdiction and authority with the title of division engineer. He served as vice-chairman during the previous year and has been a member since 1916.

THE COMMITTEE REPORTED progress in the study of the economics of filling bridges, the effect of heavier power and increased tonnage upon roadbed previously considered stabilized and the excess cost of maintenance during the early period of operation. Progress reports were presented on chemical weed killing and on the use of corrugated metal culverts in railway work and specifications for same, collaborating with the Committee on Iron and Steel Structures. These were presented as information in Appendix D and Appendix F.

Committee: C. M. McVay (K. & M.), chairman; J. C. Wrenshall (P. & R.), vice-chairman; J. B. Akers (Sou.), J. R. W. Ambrose (Toronto Term.), R. G. Aylsworth (C. B. & Q.), A. S. Butterworth (G. F. & A.), E. J. Bayer (C. C. C. & St. L.), H. W. Brown (Penna.), C. C. Cunningham (C. R. I. & P.), C. A. Daley (Erie), R. D. Garner (S. N. E.), J. S. Goodman (P. & R.), R. C. Gowdy (C. & S.), F. M. Graham (Penna.), A. Harvey (M. K. & T.), H. Hawgood (Cons. Engr.), E. G. Hewson (C. N. R.), J. R. Hoagland (G. N.), H. M. Hockman, W. M. Jaekle (S. P.), W. H. Penfield (C. M. & St. P.), W. W. Kelly (A. T. & S. F.), Frank Ringer (M. K. & T.), H. A. Roberts (O. W. R. & N.), R. B. Robinson (U. P.), G. L. Sitton (Sou.), H. E. Tyrrell (Sou.), C. E. Weaver (C. of Ga.), W. W. Wilson (G. C. & S. F.), W. H. Woodbury (D. & I. R.).

Appendix D—Chemical Killing of Weeds

Investigation shows that a comparatively small number of railroads have used chemical weed killers; however, the railroads that have used it represent a considerable portion of the mileage of the country. At least 31,500 miles of track have been treated with chemical weed killers since 1914.

The chemical composition in practically all cases is sodium arsenite, which is obtained in a concentrated solution composed of from 3.6 lb. of 4.0 lb. of arsenic, from 1.25 to 2.10 lb. of caustic soda and one gallon of water. Before application this solution is generally diluted by adding water, the final solution ready for spraying generally consisting of 1 part of the concentrated solution to 20 parts of water, although trials have been made using a solution as low as 1 to 1, and in other cases a solution as high as 1 to 40.

The most economical and extensive applications have been made with a sprinkling train, consisting of tank cars for carrying the concentrated solution, cars for water, and a car equipped with adequate sprinkling devices for reaching the width desired. The cars are so piped and equipped with air that the concentrated solution may be sprayed at practically any pressure or strength of solution. The train must be operated at a speed which will insure the discharge of the desired amount of diluted chemical solution over a given area. Applications have been made to practically all classes of weed vegetation, including Johnson grass, Bermuda grass, fox tail, sweet clover and others. The widths generally treated vary

from 12 to 18 ft., the most common being 14 ft. The average cost of the chemical used on a strip one foot wide is about $3.46 per mile. The other items entering into the cost of application are of local determination and can be best ascertained by the railroad contemplating its use.

It is necessary to take some precautions to guard against stock being killed by eating vegetation which has been treated. These precautions are, first, care in application so that the solution is not applied at road crossings or other points where stock can get at the treated vegetation, and second, the introduction of some chemical which makes the weeds treated unpalatable. The chemicals used in weed killing solutions do not have any effect on the metal portions of the railroad and cause no damage to the track.

Those who have made the most extensive tests and the most careful study of the proposition feel that they have accomplished what was expected, but we believe that there are some classes of vegetation (such as Bermuda grass and Johnson grass) which cannot be eliminated in this manner except by very persistent and continued applications covering a period of years. Furthermore, the class of ballast on the track treated, the time of treatment, character of roadbed and weather conditions have a great bearing on the results, as the best results are obtained when the chemical gets an opportunity to soak into the ground where the vegetation may absorb it through the roots.

Some railroads are going into this matter very carefully. They have been making applications for several years, and will continue them until they arrive at very definite conclusions as to whether the expense of the present chemicals and methods of application is justified by the results obtained. While admitting that some classes of vegetation have not been eliminated, they are obtaining results which they feel justify them in continuing the practice.

The Erie applies salt to weeds on some of its lines and reports satisfactory results. The salt is applied by shoveling it into chutes in the door of a box car and requires about eight-tenths of a carload per mile. The cost of this application runs about $32 per mile. The material is crushed salt, rejected because it is too coarse for market, and is obtained by the railroad free of all cost except freight charges. Care must be taken in applying salt to prevent any interference with automatic signaling.

Conclusions

1. While experiments with chemical weed killers have not been entirely satisfactory in some cases, the opinion of this committee is that where the application has been made properly, the results are generally satisfactory.
2. There is no damage to the metal portion of the railroad or to the track in the applications.

Appendix F—Corrugated Metal Culverts

It seems to be the general opinion of railroad engineers who have used corrugated metal culverts that they are not satisfactory and that their use in general railway work should be discouraged. At the same time it is hard to secure definite information as to the details of failure of these pipes. It seems from the reports submitted that to secure any reasonable service from these culverts the material must be high-grade metal as nearly pure as possible and with rust-resisting properties. Galvanizing alone is not sufficient to protect the metal from rust. Reports show also the desirability of using sheets of proper gage and that much heavier sheets must be used in the pipes of larger diameter.

Many of the reports indicate that culverts have settled into the soil in which they were laid, especially under the center of the embankment, or directly under track, causing sand and silt to collect in the invert, and hold water. This, of course, is not due to the material from which the culverts are made.

The best results seem to be secured when the top of pipe is placed not less than 3 ft. or more than 10 ft. below subgrade. Pipes should not be used with a diameter in excess of 48 in.

Some good results have been secured with the corrugated culverts under highway approaches at road crossings where the cost is much less than cast-iron or concrete pipe, and in some cases less than vitrified bell-end pipe. Some satisfactory results are also reported where the pipes have been used in construction work and the cost of hauling cast-iron or concrete pipe to the job is excessive, the corrugated pipe being later renewed with the concrete or cast-iron pipe after the track is laid up to the site.

The Committee presented three exhibits with its report covering the use of this class of culverts. One covered the installation by the Central of Georgia of corrugated iron culvert pipe inside of broken cast-iron pipes on railway embankments, as well as a report of the condition in 1920 of various corrugated iron culverts previously installed on that railway. Another related to a report made in 1920 of the condition of corrugated culverts on the Minneapolis, St. Paul & Sault Ste Marie in northwestern Wisconsin installed in 1910, and on the Duluth & Iron Range in northeastern Minnesota, installed in 1913. The third was a report on the condition of corrugated pipe culverts on a portion of the Chicago, Rock Island & Pacific in Iowa.

The Committee recommended that its report be accepted as information and progress, and subject continued until next year, when the complete specification should be ready for submission.

Discussion

(The report of the committee was presented by C. M. McVay, chairman, and by the chairmen of the sub-committees who outlined the work covered. The report of the committee was accepted as information after which the committee was dismissed with the thanks of the association.)

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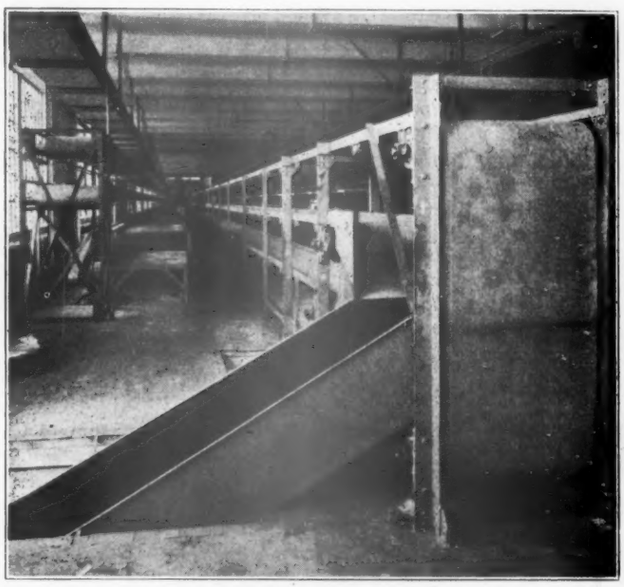


Some of the Conveying Equipment in the New Mail Terminal at the Union Station, Chicago

Where Signals Serve

Second Day's Proceedings of the Signal Section

Valuable Data on Train Operation by Signal Indication Were a Feature of the Morning Session

THE SECOND DAY'S SESSION of the convention of the Signal section, American Railway Association, was called to order promptly at 10 o'clock by Chairman Christofferson. A large attendance was present for the opening, as the report of the Committee on Economics was among the first reports to be considered. This report contained information of value on train operation by signal indication, giving a detailed study of a specific section of track. The use of such a scheme, as developed by this committee, would eliminate approximately 90 per cent of the present train orders. The Committee on Electrical Testing presented a report which will be of primary benefit to all signalmen actually engaged in field work. At the close of yesterday's session the membership adjourned to the outside of the hotel for the official photograph.

Report of the Committee on Electrical Testing

Standard instructions for the inspection and testing of alternating current relays have been needed badly in the signal field for years. Owing to the characteristics of alternating current an a. c. relay cannot be tested accurately in service by simply inserting an ammeter and resistance in the circuit as is done with a d. c. relay, on account of the fact that with the a. c. circuit the phase angle between the current and the impressed voltage must be taken into consideration. The report explains in detail with circuit diagrams and curve charts the recommended methods of testing a. c. relays and indicators both for field testing and for shop tests. A simple explanation of the effect of the local condition of the ballast and bonding on track circuit operation is included in the report. Tables of relay requirements that should be met, together with recommended forms for recording readings, make the report a complete kit of tools for the relay inspector. In this report was assembled information that several men might not be able to collect by personal observation in a life time. P. M. Gault, assistant signal engineer of the Illinois Central, has been chairman of this committee for five years and a member of the committee since 1915. He joined the Railway Signal Association in 1909 and has been an active member of other committees.

P. M. Gault
Chairman

THE COMMITTEE PRESENTED for discussion instructions on inspecting and testing alternating current relays and indicators.

Instructions for Inspecting and Testing Alternating Current Relays and Indicators

SHOP TESTS AND INSPECTIONS

1. Coils.—(a) All coils must be fixed in place to prevent their being injured by vibration.

2. Flexible Connections.—(a) Flexible conductor connecting the binding posts and contact finger must be formed and attached so as not to affect the pick-up or drop-away, and shall have sufficient conductivity to carry at least 10 amp. without overheating.

3. Contacts.—(a) Flexible part of fingers must be stiff enough to exert a contact pressure of not less than 0.5 ounce when working current or voltage is applied to the relay.

(b) Finger contacts must meet the fixed contact surfaces squarely and simultaneously, and make a wiping contact.

(c) Finger contacts must have a contact compression of not

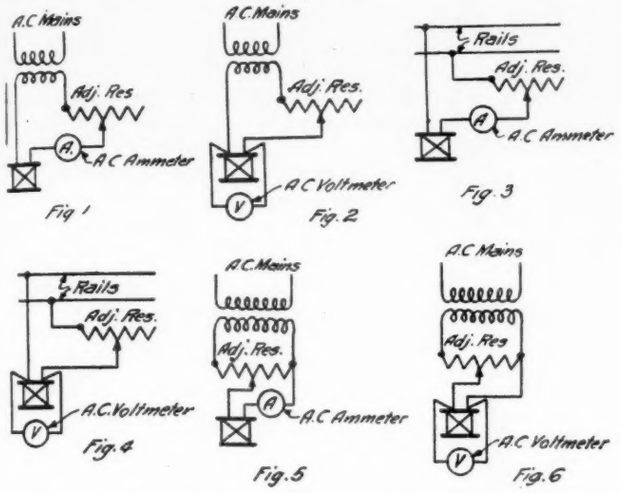
less than 0.031 in. when working current or voltage is applied to the relay.

(d) All parts of the contact fingers (other than the contact point), including its flexible connections and the post to which the ribbon is attached, must be separated by at least 0.1 in. from any other metal or conducting part of the relay.

(e) 1. Two Position Relays. (a) Opening between the finger contact and back contact surface with the front contact just closed must be in accordance with the opening specified on the table of alternating current relay and indicator requirements.

2. Three Position Relays—Normal and Reverse Contacts. (a) These contacts must be so adjusted that in their de-energized position they shall have at least the opening specified in the table of alternating current relay and indicator requirements between the fixed post and the contacting point.

3. Three Position Relays—De-energized Contacts. (a) De-energized contacts openings with normal or reverse contacts just closed must be in accordance with the opening specified



Test Connections for Track Relays and Single Element Line Relays

in the table of alternating current relay and indicator requirements.

(f) The initial cleaned contact resistance when the relay is energized at the working current or voltage must not exceed 0.5 ohm.

4. End Play.—(a) The end play of the moving element supported by bearings must be not less than 0.010 in., and not more than 0.015 in.

5. Clearance.—(a) Under the most unfavorable conditions of play and relative position of parts in the assembled relay, all moving parts except the bearings and contacts must be separated by not less than the following minimum clearances: (1) Radial 0.020 in. (2) Longitudinal 0.017 in.

6. Gaskets.—(a) Defective gaskets must be replaced.

7. Meters.—(a) Voltmeters and ammeters for testing relays must be in accordance with A. R. A. Signal section specifications. (b) Meters for shop use must be calibrated monthly.

8. Repairing.—(a) Test and inspect the relay for defects, giving special attention to those noted on repair tag A. R. A. Signal section Form 14. (1) Make repairs and adjustments. (2) Make and record test, A. R. A. Signal section Form.....

9. Testing.—(a) Pick-up, working current or voltage and drop-away must be determined as follows:

1. Pick-up—Apply a reduced current and gradually increase it until the front or energized contacts just close. This value is the pick-up. For a three-position relay, this test should be made in both normal and reverse direction.

2. Working Current or Voltage—Continue gradually increasing the current after pick-up until the moving element strikes its normal or front stop or gives the contacts a compression of 0.031 in. This value is the working current or voltage. With the three-position relay, this should be made in both normal and reverse direction.

3. Drop-away—After determining the normal working current or voltage, gradually reduce the current to the voltage at which the contacts open. This value is the drop-away.

4. Method of Varying Current—(a) In making the test for pick-up, working current or voltage and drop-away, the variation in current must be made very slowly when approaching the observed point to secure accurate results.

5. Phase Displacement—With the two-element relay the above test must be made with sufficient phase displacement between the currents in the two windings to insure satisfactory relay operation on a reasonable amount of current in the controlled element. The phase relations obtained by the different test methods will frequently vary considerably from the ideal values. The necessary increase, because of phase relations, over calibrated operating values is taken account of in the percentages given in the table of requirements for the particular test method recommended.

(b) Relay operating values must be in accordance with the shop requirements of the table of alternating current relay and indicator requirements corresponding to the type and specification number of the relay under test.

(c) Test the relay for electrical defects such as open circuits or short circuits in windings, resistors, reactors, or condensers by impressing the working voltage on each element and reading the current. With the working voltage applied, current should agree with the manufacturer's marking for working current.

(d) Test as required by A. R. A. Signal form .... must be made and recorded at the time the relay is tested.

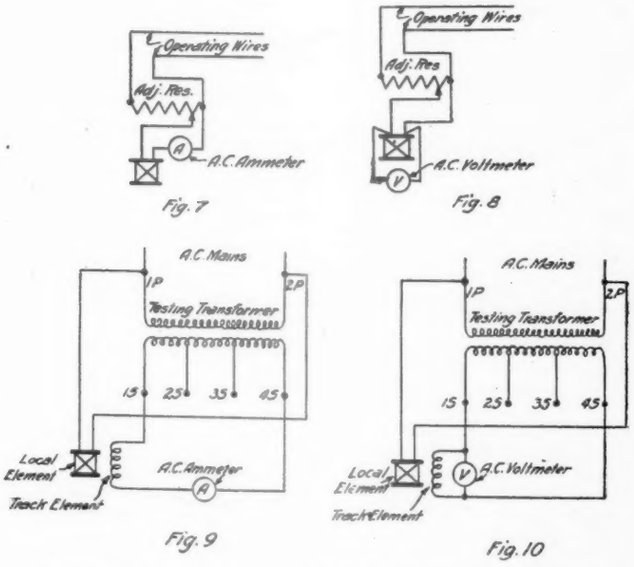
(e) The contacts of the relay must be tested for contact resistance after the case is closed and before the relay is sealed.

(f) Insulation tests must be made between windings and between binding posts and relay frames. The insulation resistance must be not less than 1 megohm. If high potential tests are made, the voltage employed should be 80 per cent of the value specified for a new relay in the Signal section, A. R. A. specification for a. c. relays and indicators.

10. Inspection.—(a) Determine by actual operation that the relay has a positive drop-away and relay contacts open without retardation of movement due to friction or external force.

(b) Inspect and clean the shaft and pivot bearing.

(c) Inspect and clean the contacts, replacing any which are badly burned or pitted.



Tests for Line Relays and Two-Element Track Relays

(d) Determine by observing operation of the relay that at least ⅛ in. clearance exists between the case and moving parts.

(e) Before the case is closed, subject relay to air blast to remove any foreign matter, then check to see that all parts are in proper position and in good condition.

11. Sealing.—(a) The relay case must be sealed.

12. Final Test.—(a) After the relay is sealed the final pick-up, working current or voltage and drop-away tests should be made. The values obtained should not vary more than 2 per cent from those of the previous tests.

13. Shipping.—(a) Relays must be tested and must meet shop requirements before shipment.

(b) Each relay must be in a separate carton or suitably wrapped before being placed in the packing box. Not more than two relays are to be placed in the same packing box.

14. Shopping.—(a) Relays must be shopped at least once every three years for shop tests, inspection and repairs.

Field Tests and Inspection

15. Meters.—(a) Voltmeters and ammeters for testing relays must be in accordance with A. R. A. Signal section specifications.

(b) Meters must be calibrated before each cycle of test and as often as necessary for field use.

16. Testing.—(a) Test required by Section 9-c and 9-f and A. R. A. Signal section form ..... must be made annually.

(b) Relay operating values must be in accordance with the field requirements of the table of alternating current relay and indicator requirements, corresponding to the type and specification number of the relay under test.

(c) The relay must meet shop requirements when it is placed in service except in emergency, when a relay meeting the field requirements may be used.

17. Inspection.—(a) It must be determined by observation that sufficient contact opening exists.

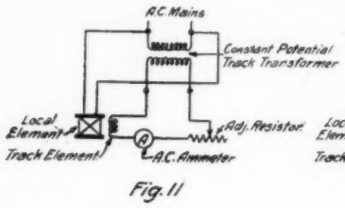


Fig. 11

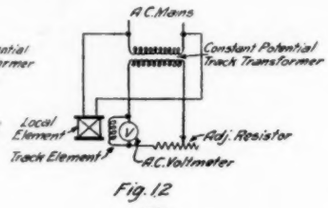


Fig. 12

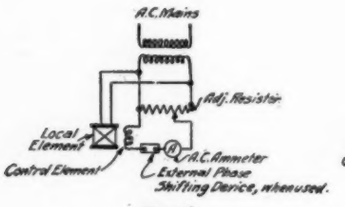


Fig. 13

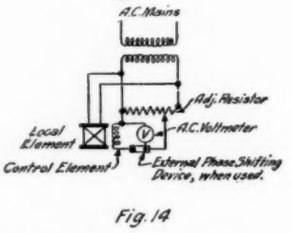


Fig. 14

Tests Using Adjustable Resistor

(b) Determine by observing the operation of the relay that at least ⅛ in. clearance exists between the case and moving parts.

(c) Parts enclosed must be free from foreign matter, in proper position and in good condition.

(d) A relay not meeting field requirements must be taken from service as promptly as possible.

(e) Relays located near points where lightning discharge has taken place should be inspected to determine if they have been damaged

18. Repairing.—(a) Repairs and adjustments to insure positive operation of a relay for temporary use in emergency, may be made in the field by an authorized relay inspector.

19. Recording.—(a) Relays must be identified by serial number, which must be recorded. Manufacturer's serial number must be used if available.

(b) Inspectors must re-mark indistinct serial numbers.

(c) A relay having an illegible or no serial number must be assigned a serial number, preceded by a letter. The letter to be used will be assigned by .....

(d) Inspector must immediately record field readings on A. R. A. Signal section form ..... which, when filled, must be forwarded to .....

(e) Field readings must be transferred weekly from A. R. A. Signal section form ..... to A. R. A. Signal section form ..... One A. R. A. Signal section form ..... must be used for each relay.

Method of Testing

20. Single Element Relays—Track Relays.—(a) Shop testing. 1. Connect the relay as shown in Fig. 1 or 2, open the circuit, then close the circuit with all resistance in series with the relay. Make tests for pick-up, working current or voltage and drop-away as outlined in Section 9, Testing.

(b) Field Testing. 1. Connect the relay as shown in Fig. 3 or 4 and proceed as outlined in Section 20-a.

21. Single Element Relays—Line Relays.—(a) Shop testing. 1. Connect the relay as shown in Fig. 5 or 6, open the circuit, then close the circuit and gradually reduce the resistance in the relay circuit. Make test for pick-up, working current or voltage and drop-away as outlined in Section 9, Testing.

(b) Field Testing. 1. Connect the relay as shown in Fig. 7 or 8 and proceed as outlined in Section 21-a.

22. Two Element Relays—Track Relays.—(a) Reactive Testing Transformer Method. Shop and Field Testing. Adjust leakage block to give zero air gap before energy is applied to the primary of the testing transformer. Connect the relay as shown in Fig. 9 or 10, then gradually increase the leakage block air gap, making test for pick-up, working current or voltage and drop-away as outlined in Section 9, Testing. This method gives the effect of an adjustable reactor in series with the relay track element, the reactance being varied by adjustment of the transformer leakage block.

(b) Adjustable Resistor Method, Shop and Field Testing. 1. Connect the relay as shown in Fig. 11, 12, 13 or 14; open the circuit then close it with all resistance in series with the relay track element. Make tests for pick-up, working current or voltage and drop-away as outlined in Section 9, Testing.

23. Two Element Relays—Line Relays. Shop and Field Testing.—(a) Connect the relay as shown in Fig. 13 or 14, open the circuit, then close the circuit, gradually increasing the voltage on the relay control circuit. Make tests for pick-up, working current or voltage and drop-away, as outlined in Section 9, Testing.

24. Phase Relation Measurements and Corrections.—(a) It is advisable to determine the phase displacement so that the operating values obtained for the relay can be corrected to the ideal phase relation if desired. This will permit checking the manufacturer's test values given on the sticker in the relay.

(b) If it is desired to determine exactly the phase relations existing under a given test condition, it is only necessary to find the angle between the relay track element voltage or current and the line (or local) voltage, by one of the methods described in Section 25. By comparing this angle with the ideal angle given in the table of requirements, the angular difference from the ideal position may be determined. Reference to the attached curve Fig. 15, will give the factor by which the calibrated values should be multiplied to obtain the operating values which should hold for the test phase relations.

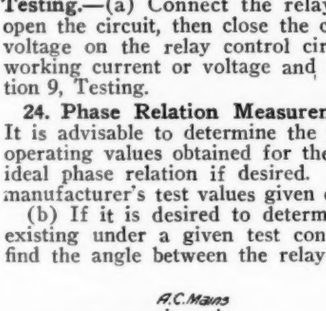


Fig. 16

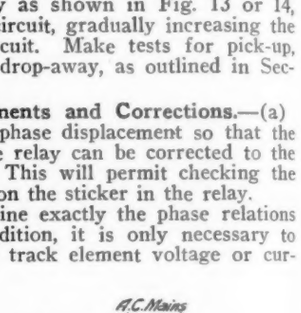


Fig. 17

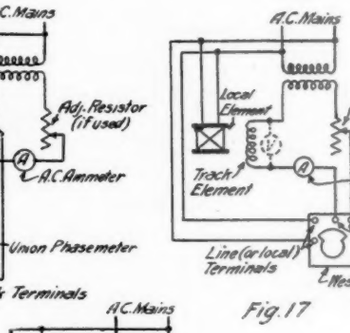


Fig. 18

Connections for Phase-Angle Measurements

25. Measurement of Phase Angles.—(a) Union Phasemeter. 1. Connect as shown in Fig. 16. The reading obtained will be the angle between the line (or local) voltage and the relay track voltage.

(b) Weston Phasemeter. 1. Connect as shown in Fig. 17. The reading obtained will be the angle between the line (or local) voltage and the relay track current.

(c) Wattmeter Method. 1. Connect as shown in Fig. 18. Divide the wattmeter reading by the product of the relay track current and the line voltage. The result will be the cosine of the angle between the line voltage and the relay track current, which angle can be found by reference to a table of cosines.

Committee: P. M. Gault (I. C.), chairman; J. S. Gensheimer (Penna.), vice-chairman; J. A. Beoddy (N. & W.), Harry Combs (L. E. & W.), Caleb Drake (C. & N. W.), C. E. Ear-

hart (A. & V.), Thos. Holt (C. U. D. Co.), W. F. Follett (N. Y. N. H. & H.), G. W. Kydd (B. & O.), Malcolm McIntyre (M. C.), F. D. Morehart (C. M. & St. P.), J. P. Muller (Southern), C. O. Seifert (B. & O.), E. B. Smith (N. Y. C.), L. L. Whitcomb (N. Y. C.).

Discussion

B. T. Anderson (D. L. & W.): Under section 3 (d), the separation of 0.1 in. is provided. Is not this very small when 0.25 in. or 0.37 in. is usually required?

L. F. Vieillard (L. I.): In the Weston phase meter method the report shows the way of obtaining the phase displacement of the current in the track element of the two element relay. You only show the angular displacement between the current in the track coil and the voltage in the local coil. Usually this is not sufficient.

J. S. Gensheimer (Penna).: A table of a.c. relay and indicator requirements is to be built up by the manufacturers for the relays to be tested. The committee believes this is somewhat easier and just as reliable for the relay inspector.

P. M. Gault (I. C.), chairman: In view of the fact that there is no further discussion, *I move that this be accepted for letter ballot. (Motion carried.)*

American Engineering Standards Committee

THE SIGNAL SECTION passed a resolution on November 21, 1922, directing the chairman to appoint a special committee to report upon the organization and activities of the American Engineering Standards Committee. W. J. Eck, signal and electrical superintendent of the Southern Railway, and A. H. Rudd, chief signal engineer of the Pennsylvania System, were appointed on this commiteee, and their report was submitted at the Signal section meeting on Thursday. Their report follows:

History

The American Engineering Standard Committee (hereafter called the Main Committee) was organized as a result of seven meetings held in 1917 and 1918 of a special committee appointed jointly by the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers and American Society for Testing Materials; to formulate some method to prevent duplication in standardization work and the promulgation of conflicting standards. The first meeting of the main committee was held on October 19, 1918. Since then several of the departments of the United States Government have designated representatives to serve on the main committee and beginning in 1919 other national bodies have been represented. The American Railway Association (Engineering Division) appointed a representative in 1921.

Objects

The objects of the A. E. S. C. are: To provide means by which various organizations engaged in formulating engineering standards may cooperate with one another, thus avoiding the duplication of standardization work and the promulgation of conflicting standards. To collect and make accessible to organizations and individuals information concerning standardization work in the United States and foreign countries. To receive and pass upon recommendations for standards submitted to it by other organizations in accordance with its rules of procedure, with the objects of establishing American Engineering Standards; but not to formulate standards. To promote in foreign countries the knowledge of recognized American Engineering Standards. To act as the authoritative channel of coöperation in international engineering standardization.

Membership

The main committee is composed of not more than three representatives from each of the national technical societies, the government departments and from such approved organizations or groups of organizations of national scope as may make formal application for representation. The number of representatives that any organization or group may appoint is determined by the volume, character and importance of its standardization work together with its standing and total membership.

Applications are first approved by the main committee and then submitted with recommendations to each organization represented upon the main committee. These recommendations will be considered approved if objections are not received from more than one-fourth of the organizations within 90 days.

Representatives are appointed for three years and the body making the appointment is required to pay $500 annually for each representative. Regular meetings of the main Committee are held four times each year and additional meetings upon call of the chairman.

Approval of Standards

The main committee formulates rules under which committees to create standards are constituted and organized and it receives and passes upon recommendations for standards which may be submitted by any competent body, who is thereafter known as the "Sponsor" for that particular item.

A proposed standard submitted to and approved by the main committee will be known as: Recommended Practice, Tentative Standard, or American Standard. The first two requires a two-thirds vote of the main committee and the advance to the status of American standard requiring the approval of the sponsor and an affirmative vote of 90 per cent, of the members of the main committee. Any of the three may be revised at intervals by the same procedure as that required for its original approval.

Method of Work

The A.E.S.C. is not an initiating body and work on a project in undertaken only upon a formal request from a responsible body, and then only after the main committee has assured itself that it is the desire of the industry that the work should go forward. The main committee thereupon requests the bodies concerned to appoint representatives to a conference at which is decided whether the work is of sufficient importance to be undertaken; if so, its scope, how the work will be carried on and its relation to other work.

If it is decided at the conference that the work should go forward, a "sectional committee" is organized by the sponsor to have charge of the necessary detail work of preparing the standard. The main committee approves the personnel and composition of the sectional committee to the end that it shall be authoritative and adequately representative of the various interests concerned in the standard.

In making up the sectional committee the sponsor determines the organization that should be represented and the number of such representation (after conference and agreement among the organization concerned) having due regard to the relative importance of the subject to such organizations in order to secure a well-balanced committee. Individuals not representatives of any body if possessing special qualifications may be asked to serve upon the committee.

After the sponsor has determined the make-up of the sectional committee it requests the various organizations to name their representatives in order that the organization may be officially represented.

Generally the membership of a sectional committee will be such that the producing, consuming and general interest will be included and neither class shall form a majority except with the consent of the others. After approval of the personnel of the sectional committee by the main committee, the work is started by the sectional committee and carried on to a conclusion by means of subcommittees or any other means the sectional committee deems proper.

Standards adopted or process prior to January 1, 1920, may be approved by the main committee if the standard has been developed by an organization and procedure substantially as required for the approval of a new standard by the main committee or if it has by actual practice proved its right to become a standard. The most satisfactory way, however, of determining the status which a standard has in industry is to submit it to a regularly organized sectional committee, and this will usually be done.

Where such a procedure will work a hardship, the main committee will, before acting upon the approval of such a standard, send a notice to the technical press and to industrial associations and technical bodies interested, requesting information as to the proposed standard and will in addition appoint a special committee to investigate the matter. This special committee will be composed of at least three members of the A.E.S.C. and representatives from organizations directly concerned.

The report of the special committee to the main committee is the basis of its recommendation with respect to the proposed standard. In this as in all of its work, the A.E.S.C. does not

consider technical details, but only procedure and status. After January 1, 1924, no standard will be approved by the main committee without having been considered by a regularly organized sectional committee.

Correlating Committees

To develop the work in any general branch of industry and to correlate the work of standardization of the industry, general committees representative of the industry as a whole may be formed. Such a committee is known as a "Correlating Committee" and at present there are two such committees functioning. These are the General Correlating Committee for Mining Standardization, and the National Safety Code Committee. Each of these committees acts in an advisory capacity, suggests subjects for standardization, recommends sponsors, defines and limits the scope of a proposed standard, assists in adjusting conflicts or clearing up ambiguities, follows up the work under way and reports from time to time upon progress made within its field of activities.

Progress of Work

At the end of the year 1922 there were 121 projects officially before the A.E.S.C., in addition to a large number that have been informally suggested. These may be classified as follows: 23 are concerned with mechanical engineering; 21 are civil engineering projects; 15 are electrical; 3 are automotive; 12 are concerned with transportation; 15 with ferrous metals; 12 with chemical; 4 with non-ferrous metals; 4 with mining; 2 with textiles; 1 with shipbuilding; and 9 projects are of general interest.

Twenty-nine standards or safety codes have been approved and 44 are up for approval. The remaining 48 projects represent codes and standards which are either in the process of formulation, or which are now being considered by committees or representatives designated by the various bodies, industrial, technical and governmental, interested in each particular subject. In this way, more than 200 such bodies are officially participating in the work of the A.E.S.C. through their accredited representatives.

The projects under way at the present time of particular interest to the members of the Signal section are: "Colors for Traffic Signals" and "Insulated Wires and Cables." Representatives have been appointed by the Committee of Direction upon the sectional committees and the technical sub-committees to fully care for the interests of the Signal section.

The work on insulated wires and cables was initiated at the request of the American Railway Engineering Association in 1921. There are 15 important specifications covering the various phases of the subject, and the work is being conducted by 12 sub-committees, each dealing with a separate phase of the subject. The Signal section is represented upon five of these sub-committees.

Work on Colors for Traffic signals was undertaken in the latter part of 1922, and has only recently gotten well under way. The Signal section is represented upon the sectional committee and a member of the Signal section has been appointed to one of the sub-committees as an individual member.

Other activities of the A.E.S.C. include a service of information pertaining to standardization here and abroad. It is planned to maintain a complete file of all American and foreign standards for free use of committees and industry generally. Copies of foreign and American standards are kept for sale and while individual standards are published by the sponsor bodies, it is planned by the A.E.S.C. to publish collectively all of the standards approved by the main committee.

There are now national standardizing bodies in Australia, Austria, Belgium, Canada, Czecho-Slovakia, Germany, France, Great Britain, Holland, Italy, Japan, Norway, Sweden, Switzerland, and the United States, making 15 in all. Close touch is kept with all of these and active coöperation with several of them.

Headquarters of the American Engineering Standards Committee are maintained at 29 West 39th Street, New York, N. Y., and specific information with respect to the activities of the A.E.S.C. can be had at the above address by communicating with Dr. P. G. Agnew, Secretary.

Report on the Economics of Railway Signaling

The report of this committee included a proposed plan for the operation of 45 miles of single track line by signal indication, whereby the track capacity is to be increased 30 per cent. The plan included the installation of three position color light signals and two interlocking plants. Passing siding switches were to be operated by distant control power switch machines. For the purpose of permitting the dispatcher to direct train movements by signal indication the line was divided into four controlled sections. The territory under the control of each station was divided into three types of zones; the interlocked zone; the distant control zone, including the signals and power operated switches controlled from a distant station; and the automatic block signal zone. The plan included a three phase transmission line with sufficient capacity for operating the pumping and coaling stations, and for lighting the stations and switch lamps, in addition to the requirements of the signal system. B. T. Anderson, assistant signal engineer of the Delaware, Lackawanna & Western, has been chairman of this committee since June, 1921. He is also a member of Committee IX—Wires and Cables, is chairman of the Committee on Committees, and is first vice-chairman of the Signal section. He served on the A. E. S. C. wires and cable conference.

B. T. Anderson
Chairman

THE COMMITTEE PRESENTED as information a proposed plan for the operation of a single track line by signal indication.

Operation of a Single Track Line by Signal Indication

Length of line is: (See plan 1)	Miles
Double track, MP 4 to MP 7	3
Single track, MP 7 to MP 49	42
Total	45

The proposed plan covers the following features:

Line to be equipped with automatic block signals, three-position, alternating current, color light type. At A and D the installation of alternating current power interlocking stations, with two and three-position semi-automatic semaphore signals. Passing siding switches to be operated by distant operation power switch machines. (See plan 2.)

For the purpose of permitting the train dispatcher to direct the movement of trains by signal indication, the line is to be divided into four controlled sections, A, B, C and D, as shown on plan 1. Controlling stations for the four sections are: Sections A and D controlled from interlocking stations A and D. Sections B and C controlled from block stations B and C. Plan shows extent of territory controlled from the four stations, A, B, C and D.

To indicate the character of the control, the territory under the control of each station is sub-divided into three types of zones:

Interlocking Zones.—In an interlocking zone the switches and signals are operated and controlled from a power interlocking station.

Distant Operation Zones.—In these zones the switches and signals are operated by power switch machines with distant control from a station. (See also plan 2.)

Automatic Zones.—In these zones the signals are automatic block signals and the switches are hand operated. The automatic block signals are not controlled from a station.

This plan is based on a three-phase a.c. 60 cycle transmission line, with sufficient capacity for operating pumping and coaling stations, lighting stations and station grounds, switch lamps, etc., in addition to the requirements of the signal system. While this plan will not, of course, provide the track capacity of a double track, it will increase the capacity of the present track approximately 30 per cent. It will pay larger returns for money ex-

pended than double tracking with its proportional increase in capacity. All signal apparatus used will be available for any parallel track that may be found necessary in the future. The following advantages will be derived through the use of the automatic block signals and interlocking.

Increase in train miles per hour without increasing train speed and decreased cost by: (a) Reduced number of train delays. (b) Reduced number of written train orders. (c) Increased supervision of train movements by dispatcher. (d) Increased safety of operation. (e) Decreased cost of train operation.

Reduced Number of Train Delays

On account of the usual long block sections under the present system of operation by time tables, train orders and manual block signals, trains cannot follow each other under close headway, thus causing serious delay, *i. e.*, a freight train waiting on a passing siding cannot follow a passenger train until the passenger train has cleared the block three or more miles in length, and again these blocks often include a station stop for the local passenger train. Blocks of irregular length are another source of delay. A point often overlooked is that the longest block section, in time, determines the headway between trains for the entire division.

Time lost by trains operating under written train orders, due to the fact that the trains are required either to slow down or to stop to receive the order, *i. e.*, an extra train running ahead of a regular train could not continue on the main track on the time of a regular train without a written train order, although the regular train may be an hour or more late. The delivery of the train order causes the extra to slow down to receive it. This illustrates one of the weak points of the written train order, as in the foregoing case, the moving train is brought almost to a stop for the sole purpose of receiving instructions ordering it to keep in motion.

With three-position signals at unattended passing sidings,* such as shown at M.P. 26, electrically controlled from the nearest station, which may be one or more miles away, it is a simple matter for the train dispatchers to cause to be displayed at the passing sidings the required signal indications for directing the train movements to be made at the sidings. Trains at the passing sidings either continue on main track or take sidings, as required by the signal indications. If they enter the siding they report by telephone to the station from which the signal is controlled. The train dispatchers' circuit, with telephones in all stations, is utilized, also local circuits from each station to the adjacent unattended passing sidings.

With the three-position signals, signal indications for directing train movements will largely replace the directing of train movements by *written* train orders. With the combination of automatic block and interlocking safety and facility in operation will be greatly increased.

Reduced Number of Written Train Orders

Train orders are written instructions that must be delivered to the conductor and engineman of the train. They must be correctly prepared, transmitted, delivered and understood. They must not be forgotten. On railroads not equipped with block systems safety of operation depends entirely upon the human element, for there is no check, either electrical or mechanical, to prevent an improper train movement should an error occur in the preparation of the order or should the order be misunderstood or forgotten.

Signal indications are instructions given by the aspects of fixed roadside signals. The subject is here dealt with as it relate to railroads equipped with automatic block signal systems. Instructions given by signal indications require less effort in preparation and transmittal than do written instructions. They are delivered to the engineman through the mechanism of the signal. The language of the signal is easy to understand and difficult to forget. Because the aspects are few in number, there is little opportunity for misunderstanding. Of more importance, the instructions conveyed by the signal are given at the point where they are to be executed, and no lapse of time in which to forget them is possible.

Under this method of train operation by signal indications, there is no use for the following Standard Code train order forms:

Form A, "Fixing meeting points."
Form B, "Directing a train to pass or run ahead of another train." This information is given entirely by the signal directing the train to "Proceed on main track," or "Take siding as required."
Form C, "Giving right to a train over another train;" covered by same method as B.
Form E, "Time Orders." Under method of operating trains by signal indication the issuing of time orders is not necessary.
Form F, "For sections."
Form G, "Extra Trains." Train orders are not required.
Form J, "Holding Orders." Not used, as signal in "Stop" position takes its place.

The following train order forms of the Standard Code remain in use, as the information covered by them cannot be given by signal indication.

Form H, "Work Extra."
Form K, "Annulling a schedule or section."
Form L, "Annulling an order."
Form M, "Annulling part of an order."
Form P, "Superseding an order or part of an order."

The form of train orders eliminated represent approximately 90 per cent of all train orders issued.

Increased Supervision of Train Movements by Dispatcher

The extensive use of the telephone makes it possible for the dispatcher to keep a close supervision over the movements of every train. The usual four methods of reporting trains are as follows: 1. By telephone train reports (O-S) from the four proposed day and night stations, A, B, C and D. 2. By telephone reports from trains taking siding. 3. By telephone reports from trains stopped in answer to signals in "Stop" position. 4. By telephone reports from trains using emergency telephone outfits at other than fixed telephone locations.

The dispatcher directs train movements of extra trains or schedule trains running late by sending telephone instructions to the signalmen at the four stations. These instructions direct the signalmen to place the signal either in a 90-degree, 45-degree or "Stop" position. If the signal is at an interlocking station, the signalman places the interlocking signal in the position directed. If the signal is at an unattended passing siding, the signalman at the station places the signal in the position directed by the train dispatcher by operating the three-position switch controlling the signal.

There is a marked difference in the simplicity of this method of directing a train movement by signal indication as compared with the written train order method. Under the written train order method the dispatcher would have issued a Form B order, the signalman would have been required to deliver the order to the train, the train would have had to slow down to receive it and finally after the train had made the movement, as required, the conductor would have had to telephone the completion of the movement. Under the method of train orders by signal indication, the dispatcher, with a few words over the telephone, would direct the station to display the required signal and the signal would be displayed at the point where the train is required to act upon it. The train would not be required to slow down to receive instructions, as the instructions are conveyed to the train by the unmistakable indication of the signal.

As a further example of the two methods, take the case of an extra train to be run ahead of a schedule train running late. Under the written method, a "19" order would be issued and the train would be required to slow down to receive the instructions directing it to continue on the main track, the slowing down of the train defeating, in a measure, the very purpose for which the instructions were issued.

Under the signal indication method, the signal in the 90-degree position will instruct the train to continue on the main track. By this method the train will not have to lose time in slowing down to receive these instructions.

Increased Safety of Operation

Safety of operation under signal indication does not depend entirely upon the human element as in the time interval method.

For example, take a train order Form A reading, "No. 1 meet No. 2 at B." This order, as is often the case, may be executed at a siding many miles distant. At the time that the train is to execute the order the engineman's mental impression of the order should be strong and clear. Because of lapse of time—perhaps an hour or more, and the multitude of subsequent impressions, the train order impression is too often weak and blurred.

The train order calls for deferred action; the signal indication call for immediate action. The movement required by a train order is seldom made upon the receipt of the order. The signal indication is a "do-it-now" order.

Decreased Cost of Train Operation

Train operation by the train order method requires the delivery of the order to the train. If the train is in motion it must slacken speed or stop to receive the order. The signal indication method, on the contrary, does not require the train to either slacken speed or stop, unless a dangerous condition exists.

The train order method, when it thus retards the movements of trains, causes loss of time to cars, engines and men. Further-

*An unattended passing siding is one at which there is no communicating station. See plan 2, showing the "Control and operation of the three passing sidings from a station." The switches and signals at the three passing sidings are all operated from the station at the center siding. The other sidings are "unattended" passing sidings.

more, it unnecessarily obstructs the particular sections of track occupied by the delayed trains, and it requires the consumption of additional fuel to regain the normal speed. The train order method, therefore, reduces the railroad output of transportation, and increases train costs.

For the purpose of determining the economic value of the proposed plan for the operation of a single track line by signal indication, a comparison has been made, showing the savings in the cost of operation of the proposed plan over the present plan of operation under time tables, train orders and manual block signals.

This comparison, which is given in detail on data sheets 1 to 4, shows the following results:

Estimated cost of proposed plan:

Automatic block signals	$210,300
Interlocking, including distant operation switch machines	513,955
Total estimated cost	$724,255

COMPARISON OF PRESENT USUAL PLAN OF OPERATION OF A SINGLE TRACK RAILWAY UNDER TIME TABLES, TRAIN ORDERS AND MANUAL BLOCK SIGNALS WITH PROPOSED PLAN OF OPERATION BY SIGNAL INDICATION

Data Sheet No. 1

Item	Plans: Present (assumed)	Plans: Proposed
1. Length of line, miles between terminals	43.6	43.6
2. Freight trains per day, average number	34.56	34.56
3. Freight trains per year, total number	12,616.	12,616.
4. Freight train miles per day: miles × trains (Item 1 × Item 2)=43.6×34.56	1,507.	1,507.
5. Train speed, miles per hour, average present plan	8.08	
6. Train speed, miles per hour, average proposed plan		12.
Freight train hours per days		
7. Present plan: Train miles per day (Item 4) / M.P. H. present speed (Item 5) = 1507. / 8.08	186.48	
8. Proposed plan: Train miles per day (Item 4) / M.P.H. proposed speed (Item 6) = 1507. / 12.		125.57
9. Freight train hours saved per day: present hours minus proposed hours (Item 7 minus Item 8) = 186.48 — 125.57		60.91
10. Freight train hours saved per year: train hours saved per day (Item 9) × 365 days = 60.91 × 365		22,232.
Locomotives and cars saved per day due to saving train hours:		
11. Locomotives saved: train hours saved (Item 9) / 24 hours = 60.91 / 24		2.54
12. Freight cars per train, average number	26.	26.
13. Cars saved: train hours saved (Item 9) × cars (Item 12) / 24 hours = 60.91 × 26 / 24		66.

Data Sheet No. 2

Item	Plans: Present (assumed)	Plans: Proposed
First cost of locomotives and cars saved:		
14. Locomotives (average cost) each × number saved (Item 11 = $60,000 × 2.54 =		$152,400.
15. Cars (average cost) each × number saved (Item 13) = $2,800 × 66. =		184,800.
Savings per year on locomotives and cars saved:		
Interest at 6%, maintenance, repairs and depreciation; locomotives at 20%, cars at 10%.		
16. Locomotives at 26 per cent. of cost (Item 14 × 26 per cent.), $152,400 × 26% =		39,624.
17. Cars at 16% of cost (Item 15 × 16 per cent.) $184,800 × 16% =		29,568.
Overtime hours per year:		
18. Assumed plan (actual number)	23,922.	
19. Proposed plan		8,544.
20. Overtime hours saved per year (Item 18 minus 19), 23922 — 8544 =		15,378.
21. Saving per year, hours saved (Item 20) × rate per overtime hour =5.75 × 15,378 =		$88,115.
Coal saved:		
22. Coal saved per year = train hours saved (Item 10) × 25 per cent. of cost of running consumption of coal per train hour, 22,232 × .79 =		17,563.
Saving in cost of stopping trains:		
23. Train stops per day; present plan	142.	
24. Train stops per day; proposed plan		71.
25. Train stops eliminated, present number minus proposed number (Item 23 minus Item 24), 142 — 71 =		71.
26. Train stops per year eliminated = stops per day (Item 25) × 365 days = 71 × 365 =		25,915.

Data Sheet No. 3

Item	Plans: Present (assumed)	Plans: Proposed
27. Wear and tear saved by eliminating stops = stops per year (Item 26) × cost per stop, 25,915 × 1.00 =		$ 25,915.
28. Coal saved per year, stops per year eliminated (Item 26) × cost of coal per stop 500 lbs. @ 0.91 = 25,915 × $0.91 =		23,583.
Saving per year by use of electric lamps in place of oil lamps:		
29. Present plan, number of oil lamps = cost of each per year, 336 × 22.31 =	$7,496.	
30. Proposed plan, number of electric lamps × cost of each per year, 336 × 3.90 =		1,310.
31. Saving per year, present cost less proposed cost (Item 29 minus Item 30), $7,496 — $1,310 =		6,186.
32. By use of electric light in stations and freight houses		1,400.
Saving per year in wages of Block Signalmen:		
33. Block sections, present plan	12.	
34. Block sections, proposed plan		52.
35. Block sections, increased number under proposed plan		40.
36. Block signalmen, present plan	39.	
37. Block signalmen, proposed plan		15.
38. Block signalmen released (item 36 minus Item 37), 39 — 15 =		24.
39. Wages saved per year (Item 38 × rate per year), 24 × 1,950 =		46,800.

Data Sheet No. 4
Summary of Estimated Savings per Year

Item	
Saving in interest, maintenance and depreciation:	
16. On cost of locomotives saved	$ 39,624
17. On cost of cars saved	29,568
21. Saving in overtime pay	88,115
22. Saving in cost of coal, account train hours saved	17,563
Saving in cost of stopping and starting trains:	
27. Wear and tear saved	25,915
28. Coal saved	23,583
31. Saving in cost of lamp lighting	6,186
32. Saving in cost of station and freight house lighting	1,400
39. Saving in wages block signalmen	46,800
Total estimated gross savings per year	$ 278,754
Less estimated expenses per year	88,668
Net savings per year	$ 190,086

Estimated annual expense of the proposed plan:	
Interest charges at 6 per cent	$ 43,455
Depreciation at 5 per cent	36,213
Maintenance and operation	9,000
Total estimated annual expense	$ 88,668
Estimated annual gross savings of proposed plan (see sheet 4)	$278,754
Estimated annual expense	88,668
Annual net saving	$190,086
Annual return on investment, per cent	26.38

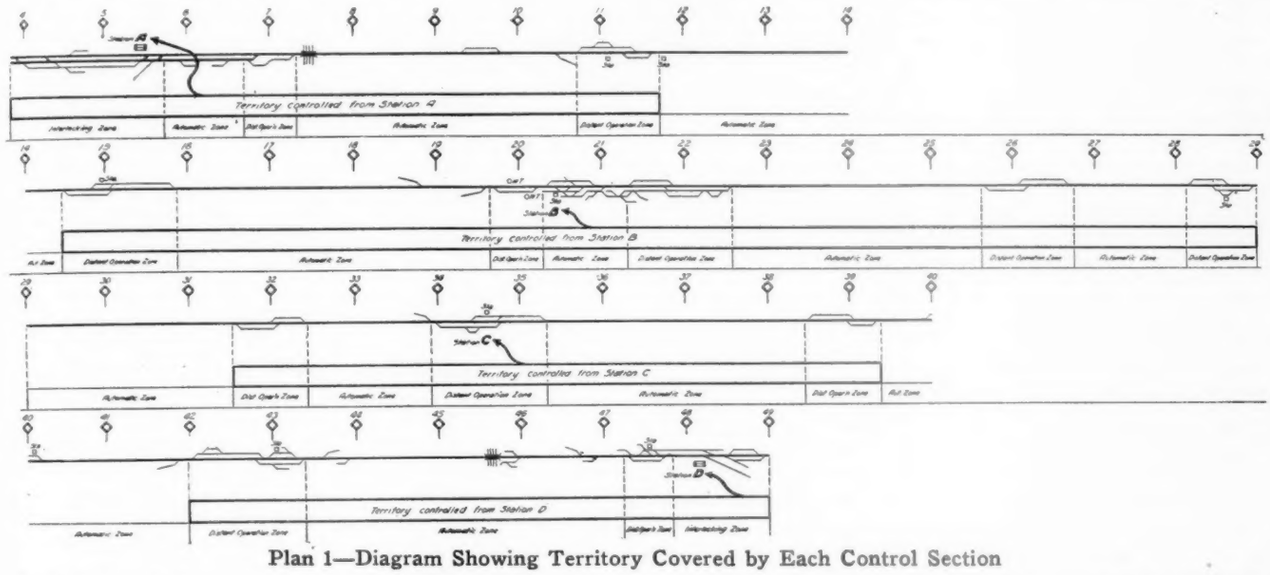
Conclusions

This report, based on the local conditions and designed to meet the requirements on one railroad, indicates that the following results may be expected by the installation of signals:

1. Average train speed increased 49 per cent.
2. Freight train hours per day reduced 33 per cent.
3. Train stops reduced 50 per cent.
4. 25,915 train stops eliminated per year.
5. Block sections increased 333 per cent.
6. Number of block signalmen reduced 62 per cent.
7. Net saving per year, $190,086.
8. Annual return on investment, 26.38 per cent.

Upon request, the committee will gladly assist railroads in preparing reports on the economics of railway signaling.

Committee: B. T. Anderson (D. L. & W.), chairman; F. W. Pfleging (U. P.), vice-chairman; W. E. Boland (S. P), O. W. Brandt (U. P.), E. B. DeMeritt (C. of G.), A. R. Fugina (L. & N.), H. F. Haag (K. C. S.), J. A. Peabody (C. & N. W.), W. M. Post (Penna.), G. S. Pflasterer (N C. & St. L.), B. J. Schwendt (T. & O. C.).


Territory controlled from Station A
Territory controlled from Station B
Territory controlled from Station C
Territory controlled from Station D

Plan 1—Diagram Showing Territory Covered by Each Control Section

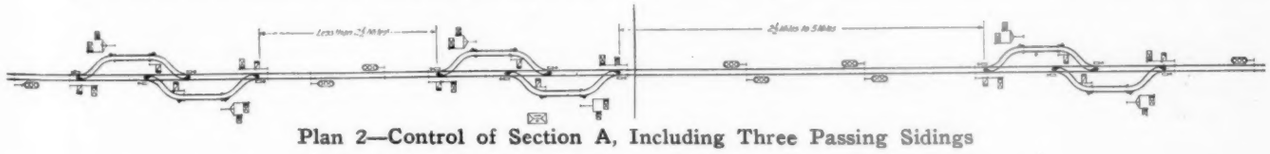
Discussion

B. T. Anderson (D. L. & W.), chairman: The members of the committee will explain some of the important features in this report. Mr. DeMerritt will explain the plan.

E. B. DeMeritt (C. of Ga.): In Plan No. 1, the territory consists of 45 mi. of road, three miles of which are double track. There are to be two interlockings, Stations A and B. There will be operators at Stations B and C. The switch at the end of double track and the switch at the end of the passing track just beyond the double track are in the distant operation zone, to be controlled from Station A, as are also those at the passing tracks, the signals and switches at and near M. P. 11.

Authority is given a train to advance from passing track at M. P. 11 to the passing track at M. P. 15 by the operator at Station A, by means of the signal at the switch. Train movements in the reverse direction between these passing tracks are under the control of the operator at Station B. There is check locking between the two stations.

The general scheme provides for the operator at each station to control the switches and signals of the passing track at the station where he is located, and in addition, those at the next station on each side. However, in case of Station B, this is extended to control the apparatus at the second passing track, the farthest switch being approximately 8½ mi. from the station. Plan 2 shows the arrangement of signals at the passing sidings.



Plan 2—Control of Section A, Including Three Passing Sidings

Chairman Christofferson (N. P.): This track arrangement, Plan No. 2, is arranged for trains to head in at the outer end of a passing track. That might be necessary on some roads, but I believe the usual custom is for them to head in at the lap. I believe that the distance is great enough to justify a pair of signals in between.

Mr. DeMerritt: This arrangement is intended to permit the use of either one. In other words, where a low arm is displayed it is for a man to take either the first switch he comes to or the second.

T. S. Stevens (A. T. & S. F.): I interlocked one or two of these lap sidings at one time, and the operating people insisted on having signals provided so that the outlying switch can be used. They claimed that the best place to have the equipment was at the center of the siding, if possible, so that they could get their orders through and get trains moving as quickly as possible from the siding. And it is true that at these particular places we did have a second signal for the inner switch. I think you will find many roads are heading trains in on the outlying switches on lap sidings.

F. L. Dodgson (Gen. Ry. Sig. Co.): To get the full value of a lap siding, it is customary on most roads now

to head trains in at the second switch, so that a meeting train at the same time can head in at this second switch. Now, with trains of nearly 100 cars, and a closed lap, the distance of trains in the outlying track and the head-in on the second siding is nearly 4,000 ft., which is a long distance to control a switch. Another thing, there being no other signal to control the two switches at the lap, the interlocking would have to be such that when a train is moving up to take the second siding, both of those switches would have to be locked so that another train could not enter in the opposite direction.

It would be fine if we could move trains on single track by signal indications only, but there are one or two great difficulties in doing that. It is almost necessary in some cases that some other information be given to the men operating trains than can be given to them with the ordinary set of signals. There may be two sections or three sections of a train, and in some cases it may be the wish of the dispatcher to run the one train between two sections. In another case, he may want to let the two sections pass. Now, an operator that is handling a set of switches that is six or seven miles away from him must know when one train has passed the set of switches and when two trains or three trains have passed, so that he can tell the right time to let the train out from the siding.

Now, in transmitting "19" orders to a train, there is very little time lost, as they can be transmitted at practically the full speed at which such trains can run, so that a few orders given in connection with signal indication would obviate this point.

Mr. Anderson: The members appreciate that the proposed method is not typical. We are not suggesting a typical scheme for every railroad. That is not the function of the Economics Committee. We have taken a problem, with certain pieces of track, and have shown what we believe can be accomplished under that scheme.

A. R. Fugina (L. & N.): The following is a statement of essential features of the proposed scheme of signaling:

1. Increased train miles an hour without increasing train speed, and by reducing operating costs. 2. The removal of the mental hazard from enginemen, trainmen, operators and dispatchers. 3. It is mainly a freight train operating problem. 4. The per cent ratio of savings in speed will increase with any increase in the number of trains operated. 5. Its actual value as a safety measure.

Mr. Anderson: Mr. Schwendt will take up the question of the reduced number of written train orders.

B. J. Schwendt (T. & O. C.): The report refers to the elimination of certain standard code forms and the retention of others. This plan provides for the elimination of the superiority of trains but retains the scheduling of trains, scheduling everything possible. That, of course, gives any scheduled train the right to leave the terminal without a written order, but under Forms F and G, which refer to extra trains, of course some orders are still necessary.

In Form A, "fixing the meeting points," the procedure is practically the same as between two adjacent interlocking plants where the operators each have advance notice of the trains. Knowing the time tables of those trains, the best meeting points may be used. Under this plan of eliminating the superiority of trains and retaining only the schedules, confusion on the part of crews in figuring the rights of trains is simplified.

A written comment from O. W. Brandt (U. P.) is as follows: "Under our present method of operation of trains it usually requires from one to ten or more train orders to handle a late passenger train over one dispatcher's territory. In case it could be done with only one order and if it is delivered to ten inferior trains, there are eleven operators to handle it. Including the operators and trainmen who handle this order, there is a total of 88 chances for error. It will probably require five train orders on an average instead of one, and if it does, it means five times 88, or 440 chances for error. A comparison of that, for example, with the plan herein outlined should convince anyone of the superiority of the operation of trains by a signal indication. I have predicted for years that the time is coming when trains will be operated entirely by signal indication and without train orders."

Mr. Dodgson: I would like to call the committee's attention to the system which has been in operation on the B. R. & P. for about six years, known as the peg system. It is not a schedule system, but one in which there are certain leaving times on which a train can be sent out or not just as the dispatcher requires.

Mr. Stevens: In a particular case, there was a three per cent grade out of a terminal with trains handled by four engines. The trains started a half of a mile from the operator's office and first received five or six orders each. When some change occurred the whole forty orders had to be taken down. In the meantime all chance of getting the freight train started was gone. There is no question about the flexibility of handling trains on some form of signal indication.

Mr. Anderson: One question that was raised about the cost was whether it would not be better to spend $700,000 for additional double track rather than to spend such a large amount for signaling.

W. M. Post (Penna.): An estimate was prepared for double tracking this line. The cost, complete, with signals, was approximately $3,270,000, and the net return on the investment was only $29,562. It would appear that the double tracking of the line was out of the question, when by spending $750,000 for signaling it was possible to save approximately $195,000. If a road required a simple system of A. P. B. signaling, such system could be installed for considerably less. It would be very necessary to take each case on its merits and work up a similar report.

Mr. Anderson: Item 14 refers to the cost of locomotives and cars. The question was raised as to whether these amounts were quite high. The January 6 issue of the *Railway Age* shows a variation between $20,300 and $76,000 for locomotives purchased last year. The prices given for cars vary between $1,100 and $2,800. The figures used in the report were actual costs of 1920.

H. M. Sperry: The Midland Railway, one of the large railway systems of England, has worked out a "path system" of operation with established paths, or what we might call schedules, or what Mr. Dodgson referred to as the peg system. Orders are issued that no trains should be run except on these paths. In other words, the capacity of the road is determined and operated accordingly.

This particular report, as you will note, refers to trains of twenty-six cars in length, and therefore that may explain the arrangement of the signals. I feel that the report has been worked out along conservative lines and I feel it is a strong effort to show the value of operating trains by signals. We will admit that there are certain emergencies that will occur where the train order may come into use, but as a general proposition the uniformity of operation under a proper and adequate signal system, with proper and adequate facilities, will reduce the use of train orders because train orders are emergency operation.

The report was accepted as information.

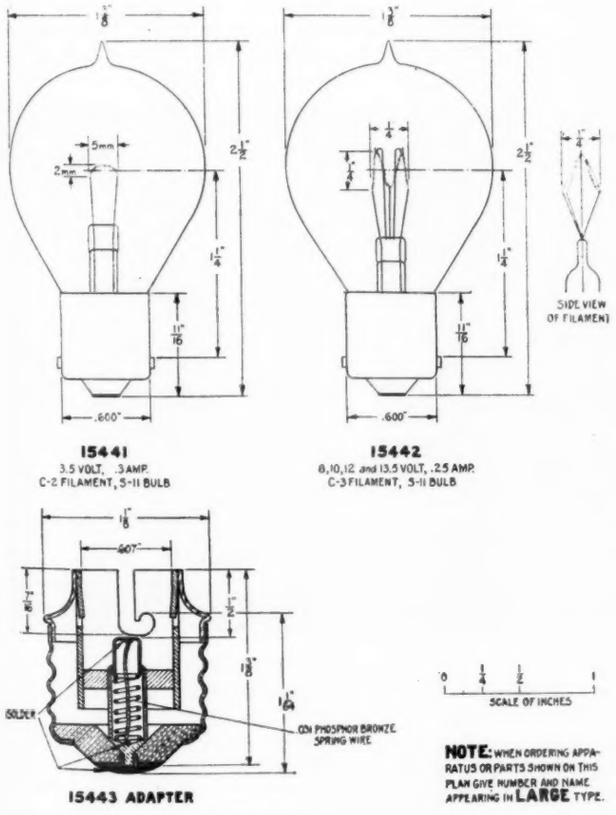
Report of Committee on Standard Designs

This committee has continued the work of standardization and presented several revised drawings, including those for binding posts, foundations for ground mast signals; concrete battery boxes; signal blades; torque curves for electric semaphore spectacles; gage plates with insulated butt joints; and gage plates with insulated lap joints. Five new drawings including attachments for switch fittings were presented in addition to new drawings for electric lamps and adopters; and a layout for mechanical dwarf signal, showing clearances. Progress was reported on a design for a concrete bell post and a concrete relay post. The committee has made a study of electric lamps for night indications and tests are being conducted on 58 roads to determine the most satisfactory electric lamp to be standardized. The extensive introduction of electric lamps to replace oil lamps on automatic signals makes it important that lamps for this purpose be standardized as soon as possible in order to simplify manufacture and to reduce the stock required by the railroad. F. P. Patenall, signal engineer of the Baltimore & Ohio for the last 24 years, has been chairman of this committee for eight years. Mr. Patenall entered railroad service in the signal department of the Lancashire & Yorkshire Railway in England in 1881.

F. P. Patenall
Chairman

THE COMMITTEE SUBMITTED for approval the following revised drawings, with the recommendation that they be accepted for letter ballot:

A.R.A Sig. Sec. 1070.—Binding Posts, Assembly and Details. Revised to show two additional sizes of binding posts, viz. 10-30 and $\frac{3}{16}$ in.-18. A.R.A. Sig. Sec. 1107.—Foundation for Ground Mast Signals. Revised to show optional trunking run in dotted lines; title changed omitting word "mechanical." Drawing 1343.—Concrete Battery Box. Revised to show reference to A.R.A. Signal Specification 11622. R.S.A. 1065.—Signal Blades. Revised note to read: "Back of blades to be painted same as stripe." With this revision not more than two colors are needed. R.S.A. 1064.—Torque Curves for Electric Semaphore Spectacles. Revised, raising friction line to eight pounds. 1343.—Gage Plate—Insulated Butt Joint. 1454.—Gage Plate—Insulated Lap Joint.


15441
3.5 VOLT, .3 AMP.
C-2 FILAMENT, S-11 BULB
15442
8,10,12 and 13.5 VOLT, .25 AMP.
C-3 FILAMENT, S-11 BULB
SIDE VIEW OF FILAMENT
15443 ADAPTER
SOLDER
.031" PHOSPHOR BRONZE SPRING WIRE
SCALE OF INCHES
NOTE: WHEN ORDERING APPARATUS OR PARTS SHOWN ON THIS PLAN GIVE NUMBER AND NAME APPEARING IN LARGE TYPE.

Standard 1544 Electric Lamps and Adapter

The committee submitted for discussion and approval, the following new drawings:

A.R.A. Sig. Sec. 1544.—Electric Lamps and Adapter A.R.A. Sig. Sec. 1545 (new drawing).—Mechanical Dwarf Signal Layout Showing Clearance. 1531.—Single Switch—Assembly: Attachment—Operating and Front Rods. 1532.—Movable Point Frog—Assembly: Attachment—Operating and Front Rods. 1533.—Double Slip Switch—Assembly: Attachment—Operating and Front Rods. 1534.—Single Switch—Assembly: Attachment—Operating and Front Rods. 1535.—Double Slip Switch and Movable Point Frog—Assembly: Attachment—Operating and Front Rods.

2. Electric Lamps for Night Indications

At the November meeting, Mr. Porter of the General Electric Company gave a talk as to the laboratory evolution in the production and tests of electric lamps. The railroads in the meantime have been co-operating in having conducted tests of the proposed standard lamps.

It must be admitted that the proposed standard lamp, both with or without reflectors, has produced much better signal lights and more intense than those produced in the use of the ordinary 2½ watt Mazda lamps generally used in the past.

The committee communicated with 58 signal engineers on the subject of tests being made of these lamps, and replies received indicated that 31 roads were making tests of lamps of voltages 3.5, 8, 10, 12 and 13.5. Replies indicated that generally lamps had not been in service long enough to give an opinion as to their merits, and the committee asked that members present give it the benefit of their experience to date.

The committee, however, desires to point out another feature of importance in the use of these lamps, and that is the matter of correctly focusing the lamps by the proper methods of adjustments, as from this so much better results can be obtained. In light signals the methods followed in basing the lamps is expensive and it is questionable whether the replacement of the bulb will not require some means of adjustment. Simple mechanical means are obtainable for application with electric lamps used in the standard R.S.A. lamp boxes and advantage ought to be taken of such means to improve the present night light signals.

3. Designs for Concrete Bell Post and Concrete Relay Post

The committee reports progress and expects to submit drawings at a later meeting.

Enameled Steel Signal Blades

The committee is continuing its investigations in the matter of recommending standard weights of steel for signal blades together with tolerances in total weights after enameling.

Committee: F. P. Patenall (B. & O.), chairman; E. K. Post (P. R. R.), vice-chairman; C. A. Christofferson (N. P.), C. J. Kelloway (A. C. L.), B. H. Mann (M. P.), J. C. Mock (M. C.),

C. H. Morrison (N. Y. N. H. & H.), F. W. Pfleging (U. P.), M. E. Smith (D. L. & W.), T. S. Stevens (A. T. & S. F.).

Discussion

(*Revised Drawings 1070, 1107, 1343, 1065, 1064, 1373, 1454 were accepted for submission to letter ballot.*)

E. K. Post (Penna.), vice-chairman: Since the drawing 1544, Electric Lamps and Adapters, was made up several changes have been suggested, as follows: The lamp to be made tipless, the over-all dimension changed to 2⅞ in., the height of the base to be ¾ in., and possibly reduce the size of the filament to 5/32 in. This is submitted for discussion.

E. G. Stradling (C. I. & L.): Has the adapter been tried out; and has there been any experience with the coils becoming loose?

F. W. Pfleging (U. P.): I have about 400 of the adapters in use and I have had no trouble with them, and possibility there are 1,700 of the lamps in service on the Union Pacific.

(*The drawing on the bonding of manganese frogs was turned back to the committee.*)

C. J. Kelloway (A. C. L.): I would like also to call attention to the fact that if the association approves of these typical layouts, 1534 and 1535, that the committee will then prepare the detail drawing for the rod, for the various equipment, but we did not want to go into the details until the typical scheme was approved.

After considerable discussion, drawings 1532, 1533, 1534 and 1535 were approved for submission to letter ballot for inclusion in the Manual.

The A. R. E. A. Elects New Officers

Results of the Annual Election Announced Yesterday—E. H. Lee Elected President for Ensuing Year

SHORTLY BEFORE THE CLOSE of the session yesterday afternoon, President Campbell announced the election of officers for the ensuing year, as follows:

President, E. H. Lee, vice-president and chief engineer, C. & W. I., Chicago.

Vice-president, J. M. R. Fairbairn, chief engineer, C. P. R., Montreal, Que.

Secretary, E. H. Fritch.

Treasurer, George H. Bremner, C. B. & Q., Chicago.

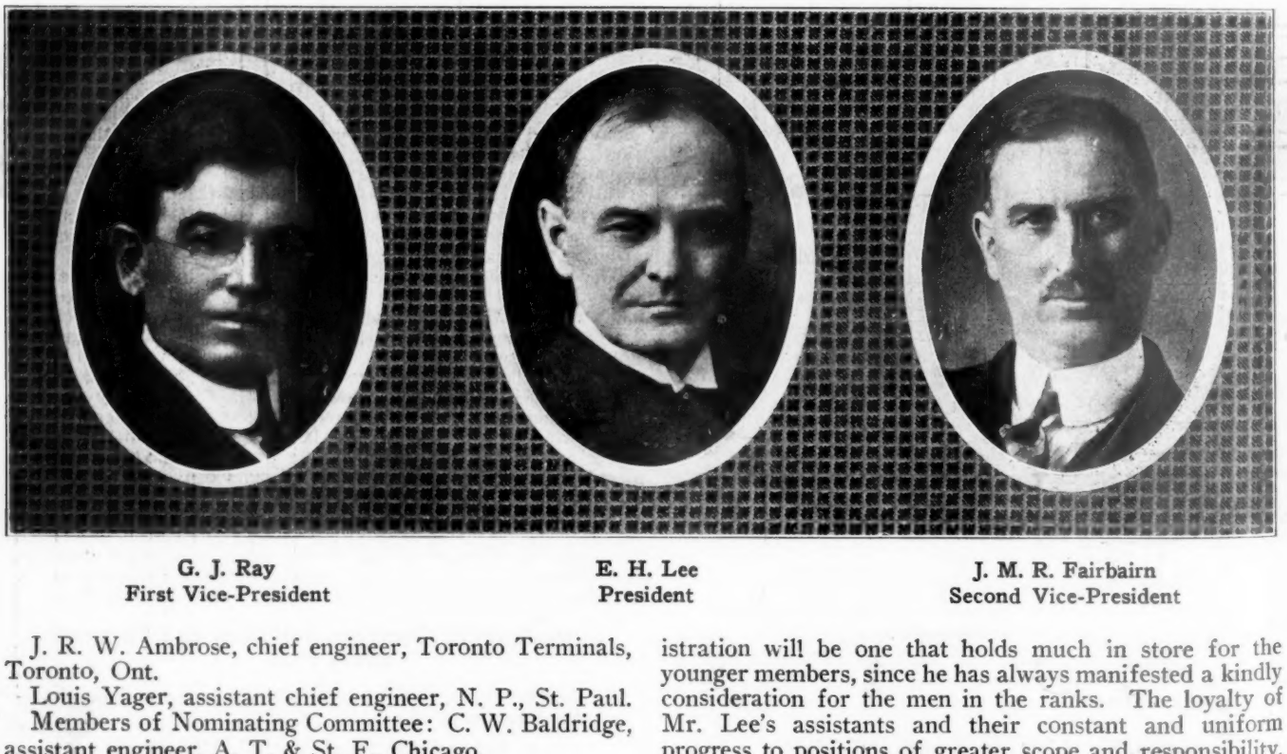
Directors: F. J. Stimson, chief engineer maintenance of way, Southwestern region, Penna., St. Louis.

W. H. Penfield, engineer maintenance of way, C. M. & St. P., Chicago.

Edward H. Lee, President of the American Railway Engineering Association

In Edward H. Lee the association has obtained a president possessing the qualities of leadership so essential for the effective presiding officer and the successful executive, yet endowed with those human attributes which endear him to the members as an individual. If we are to judge by his record in other organizations, his administration will be one that holds much in store for the younger members, since he has always manifested a kindly consideration for the men in the ranks. The loyalty of Mr. Lee's assistants and their constant and uniform progress to positions of greater scope and responsibility, both in the Western Indiana organization and elsewhere, throw some light upon his methods and ideals of efficient organization.

While Mr. Lee has not been given to an active part to discussions on the floor of the convention and has been



G. J. Ray
First Vice-President

E. H. Lee
President

J. M. R. Fairbairn
Second Vice-President

J. R. W. Ambrose, chief engineer, Toronto Terminals, Toronto, Ont.

Louis Yager, assistant chief engineer, N. P., St. Paul.

Members of Nominating Committee: C. W. Baldridge, assistant engineer, A. T. & St. F., Chicago.

W. A. Clark, chief engineer, D. & I. R., Duluth.

C. E. Denney, vice-president and general manager, N. Y., C. & St. L., Cleveland.

H. N. Rodenbaugh, chief engineer, F. E. C., St. Augustine, Fla.

wont to spend more time in the corridors than in the Florentine room, he has always been an active worker in the interest of the association. To judge accurately of his efforts in behalf of the A. R. E. A., one must go back some years into the association's history, for his membership number is 124 and there are at present on the rolls of the association only 43 men whose membership antedate his. In more recent years his part in the technical activities of the association has been related primarily to the work of the Committee on Uniform General Contract Forms, on which he served for 13 years, during five of which he held the position of chairman. But aside from his part in the prosaic, though exceedingly important work of this committee, Mr. Lee has long pursued a special field of study from which the association has derived much benefit. This is his work on the handling of less than carload freight with mechanical equipment. A pioneer in this field of endeavor, he is responsible in large part for the formulation of the economic principles underlying the power trucking of freight as set down in two personal reports published in bulletins of the association.

An Ohioan by birth, Mr. Lee began his technical training at the University of Ohio and supplemented it by two years at Worcester Polytec. After leaving school there followed a period during which he was afforded ample opportunity to acquire that breadth of knowledge which can come only from a varied experience scattered over the wide field. He was employed during this time for varied periods on the Union Pacific, the Wisconsin Central, the Scioto Valley Railway and the Nickel Plate. However, the major portion of Mr. Lee's railway engineering experience has been gained in the immediate vicinity of Chicago. Following four years with the Elgin, Joliet & Eastern and four more years in varied employment, including work on the Chicago Drainage Canal, he was appointed engineer and general roadmaster of the Chicago & Western Indiana and the Belt Railway of Chicago and for the past 25 years has been in the continuous employ of those properties. He was advanced in time to chief engineer and in 1915 to vice-president and chief engineer, a position he has occupied to this date except during the period of government control, when he represented the interests of the stockholders as president. During his 25 years as chief engineer, Mr. Lee has directed the elevation of some 150 miles of track and has designed and supervised the separation of grades between railroads at several points in Chicago. He has also collaborated in the design and construction of similar separations at other points. He has more than doubled the track mileage of his companies and has built various new classification yards, including Clearing Yard, which, when completed, will be the largest in the country. In the course of this work he inaugurated many new methods of track elevation including the adaptation of various kinds of machinery to this work as a substitute for hand labor, involving much pioneering in the use of the plow and spreader method of building embankment; the mechanical handling of concrete direct from mixer to wall and the more extensive use of the locomotive crane for the handling of materials, the throwing of tracks and the raising of temporary trestles.

Mr. Lee's studies of railroad terminal problems coincide with his service on the Western Indiana. He has studied several phases of the freight situation in Chicago and has reported thereon to his company, and he collaborated with Alfred Fellheimer and associates, architects and engineers of New York City, in the plans for the new terminal development at Dearborn station, which have recently been made public.

A. R. E. A. Registration

THE REGISTRATION at the American Railway Engineering Association convention yesterday aggregated 154 members and 47 guests, making a total for the day of 201. Including the registration of 587 yesterday, this brings the total registration up to 788. This compares with a registration of 859 for the two days last year and 718 during 1921.

Ackerman, F. J., sig. engr., K. C. Ter., Kansas City, Mo.
Albright, C. C., prof. civ. engrg., Purdue University, Lafayette, Ind.
Ambrose, J. R. W., chf. engr., T. T., Toronto, Ont., Can.
Bainbridge, C. N., engr. of design, C. M. & St. P., Chicago.
Baldwin, R. A., dist. engr., C. N., Toronto, Ont., Can.
Baldwin, Springfield, U. S. R. A., div. of liq. claims, Washington, D. C.
Ballard, E. E., office engr., M. K. & T., St. Louis, Mo.
Barry, G. R., supt., Penna. Sys., Richmond, Ind.
Bassett, J. S., div. engr., Mo. Pac., Atchison, Kan.
Baxter, J. J., div. engr., Wabash, Peru, Ind.
Bayer, E. J., engr. maint. of way, E. I. & T. H., Washington, Ind.
Beach, D. P., div. engr., Penna. Sys., Indianapolis, Ind.
Beahan, Willard, 1st asst. engr., N. Y. C., Cleveland, Ohio.
Bell, Gilbert J., engr. west. dist., A. T. & S. F., Topeka, Kan.
Bennett, W. R., asst. engr., Wabash, Moberly, Mo.
Blanchard, A. M., pilot engr., val. dept., G. T., Montreal, Can.
Boots, E. W., engr. maint. of way, P. & L. E., Pittsburgh, Pa.
Bradley, A. C., div. engr., C. R. I. & P., Fairbury, Neb.
Brown, H. W., div. engr., Penna., Zanesville, O.
Bryant, C. T., asst. engr, maint. of way, C. C. C. & St. L., Wabash, Ind.
Buck, J. A., asst. engr., Wabash, Montpelier Ohio.
Buehler, Walter, consult. engr., The Barrett Company, New York City.
Burnett, W. S., engr. maint. of way, C. C. C. & St. L., Springfield, Ohio.
Burns, J. F., asst. engr. maint. of way, L. & N., Louisville, Ky.
Butler, E. S., asst. val. engr., M. K. & T., Parsons, Kan.
Carothers, J. B., asst. to gen. mgr., B. & O., Western Lines, Cincinnati, Ohio.
Carrick, O. W., water engr., Wabash, Decatur, Ill.
Cheney, B. M., gen. insp. permanent way, C. B. & Q., Chicago.
Church, S. R., technical advisor, The Barrett Company, New York City.
Clark, H. G., asst. to pres., C. R. I. & P., Chicago.
Clement, S. B., chf. engr., T. & N. O., North Bay, Ontario, Can.
Cleveland, G. C., chf. engr., N. Y. C., west of Buffalo, Cleveland, Ohio.
Clift, A. E., gen. mgr., I. C., Chicago.
Coates, F. R., pres., Tol. Ry. & Lt., Toledo, O.
Colladay, W. E., asst. engr., I. C., Chicago.
Comstock, G. F., met. engr., Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Condron, T. L., const'l. engr., Monadnock Bldg., Chicago.
Cooper, S. B., gen. engr., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Correll, E. J., div. engr., B. & O., Akron, Ohio.
Crowell, F. N., div. engr., Penna. Sys., Logansport, Ind.
Crugar, E. L., engr. of constr., I. C., Chicago.
Cunningham, C. C., div. engr., C. R. I. & P., Herrington, Kan.
Dale, L. E., supervisor, Penna. Sys., Philadelphia, Pa.
Dart, C. R., consult. engr., 6 N. Michigan Ave., Chicago.
Davidson, J. C., engr. elec. traction, N. & W., Bluefield, W. Va.
Davidson, W. A., asst. engr. Mo. Pac., Sedalia, Mo.
Davis, Garrett, div. engr., C. R. I. & P., Cedar Rapids, Ia.
Denney, C. E., vice-pres. and gen. mgr., N. Y. C. & St. L., Cleveland, O.
Dewees, A. R., div. engr., P. M., Detroit, Mich.
Dick, H. B., asst. val. engr., B. & O., Baltimore, Md.
Disney, C. P., bridge engr., C. N., Toronto, Ont., Can.
Dorrance, W. T., designing engr., N. Y. N. H. & H., New Haven, Conn.
Downs, J. L., roadmaster, I. C., Champaign, Ill.
Doyle, T. L., asst. to chf. mgr., Penna. Sys., Detroit, Mich.
Elliott, Leigh B., engr. maint. of way, C. C. C. & St. L., Indianapolis, Ind.

Ellis, P. O., acctg. engr., M. K. & T., St. Louis, Mo.
Engle, C. W., engr. maint. of way, C. C. C. & St. L., Wabash, Ind.
Everham, A. C., west. con. mgr., Raymond Concrete Pile Co., Kansas City, Mo.
Farlow, G. B., asst. engr., B. & O., Western Lines, Cincinnati, Ohio.
Fithian, E. B., div. engr., Mo. Pac., Kansas City, Mo.
Freygang, A. H., div. engr., B. & O., Grafton, W. Va.
Gaby, F. A., chf. engr., Hydro-Electric Power Commission, Toronto, Ont., Can.
Gaines, R. H., engr. maint. of way, T. & P., Dallas, Texas.
Gibson, Andrew, supt. timber preservation, N. P., Brainerd, Minn.
Hammond, E. W., engr. maint. of way, B. R. & P., Rochester, N. Y.
Hand, G. W., asst. to pres., C. & N. W., Chicago.
Hanna, John V., chf. engr., K. C. T., Kansas City, Mo.
Harrington, C. J., roadmaster, Y. & M. V., Memphis, Tenn.
Harris, W. J., div. engr., C. B. & Q., LaCrosse, Wis.
Hawthorne, F. M., div. engr., Penna. Sys., Terre Haute, Ind.
Hayes, H. C., asst. engr., I. C., Champaign, Ill.
Hayes, V. R., supr. track, Wabash, Forrest, Ill.
Hayes, W. P., div. engr., Mo. Pac., Monroe, La.
Heidenthal, W. C., engr. maint. of way, N. Y. O. & W., Middletown, N. Y.
Hoagland, J. R., chf. pilot engr., C. & A., Chicago.
Hobbs, W. H., asst. engr., Mo. Pac., St. Louis, Mo.
Hogue, C. J., West Coast Forest Products Bureau, New York City.
Hood, J. M., supt., A. C. & Y., Akron, Ohio.
Hopkins, A. T., asst. val. engr., M. C., Detroit, Mich.
Houston, W. O., div. engr., M. C., Jackson, Mich.
Hunley, J. B., engr. bridges and structures, C. C. C. & St. L., Cincinnati, Ohio.
Huntsman, F. C., asst. engr., Wabash, Springfield, Ill.
Irwin, A. Chas., engr. struct. bureau, Portland Cement Association, Chicago.
Johnson, J. E., div. engr., P. M., Saginaw, Mich.
Johnston, D. B., div. engr., Penna. Sys., Louisville, Ky.
Kelley, W. J., instmn., C. R. I. & P., Des Moines, Iowa.
Kent, A. S., chf. engr., C. I. & L., Chicago.
Ketchum, M. S., dean, College of Engineering, University of Illinois, Urbana, Ill.
Kimble, W. P., asst. engr., Erie, Galion, Ohio.
Kissell, J. E., engr. maint. of way, C. C. C. & St. L., Mt. Carmel, Ill.
Konold, G. F., gen. mgr., Warren Tool & Forge Company, Warren, Ohio.
Kulp, B. R., div. engr., C. & N. W., Madison, Wis.
Longshore, R. L., asst. engr., Wabash, St. Louis, Mo.
Loweth, C. F., chf. engr., C. M. & St. P., Chicago.
Mann, B. H., signal engr., Mo. Pac., St. Louis, Mo.
Merwin, C. E., chf. engr., D. T., Detroit, Mich.
Miller, L. C., asst. chf. engr., M. & S. L., Minneapolis, Minn.
Morrow, F. E., asst. chf. engr., C. & W. I., Chicago.
Moss, J. A., gen. contr. ry. structures, 608 S. Dearborn St., Chicago.
Murray, W. A., engr. of track, N. Y. C., New York City.
Norris, G. L., met. engr., Vanadium Corp. of America, New York City.
Ogle, W. F., sales mgr., U. S. Truck Sales Co., 7254 Harvard Ave., Chicago.
Parsons, O. V., asst. engr., N. & W., Bluefield, W. Va.
Passel, H. F., chf. engr., C. I. & W., Indianapolis, Ind.
Passmore, E. W., div. engr., C. B. & Q., Lincoln, Neb.
Peterson, John, St. L. S. W., Illmo, Mo.
Porter, H. T., chf. engr., B. & L. E., Greenville, Pa.
Purdy, J. W., asst. div. engr., B. & O., Garrett, Ind.
Radspinner, W. A., spec. engr., B. & O., Western Lines, Cincinnati, Ohio.
Ramsey, F. R., chf. engr., T. St. L. & W., Frankfort, Ind.
Raymer, A. R., chf. engr., P. & L. E., Pittsburgh, Pa.
Raymond, Wm. G., dean, College of Applied Science, State University of Iowa, Iowa City, Iowa.
Rist, C. J., div. engr., P. M., Saginaw, Mich.
Rogan, J. E., rdmstr., I. C., New Orleans, La.
Rose, L. S., asst. to gen. mgr., C. C. C. & St. L., Cincinnati, Ohio.
Russell, W. E., roadmaster, I. C., Clinton, Ill.
Saunders, H. R., supt., C. R. I. & P., El Reno, Okla.
Seely, S. A., asst. div. engr., N. Y. C., Utica, N. Y.
Senter, S. S., chf. engr., A. C. & Y., Akron, Ohio.
Sessions, O. H., gen. roadmaster, D. & T. S. L., Monroe, Mich.
Shaw, H. J., div. engr., Penna. Sys., Cambridge, Ohio.
Sheahan, J. T., div. engr. Wabash, Moberly, Mo.
Sitton, G. L., engr. maint. of way, Southern, Danville, Va.
Smith, C. U., dist. engr., C. M. & St. P., Milwaukee, Wis.
Smith, D. W., val. engr., H. V., Columbus, Ohio.
Smith, G. H., div. engr., T. & O. C., Bucyrus, Ohio.
Smith, H. R., asst. engr., P. M., Detroit, Mich.
Smith, Lowry, asst. dist. engr., Nor. Pac., St. Paul, Minn.
Snyder, J. A., div. engr., M. C., Detroit, Mich.
Sparks, A. L., architect, M. K. & T., St. Louis, Mo.
Sperry, H. M., 347 Madison Ave., New York City.
Stewart, G. H., supervisor, Penna. Sys., Newark, Del.
Sturdevant, C. F., div. engr., C. B. & Q., Lincoln, Neb.
Taylor, E. B., Jr., supt., Penna. Sys., Cambridge, Ohio
Teal, J. E., special engr., B. & O., Baltimore, Md.
Temple, E. B., asst. chf. engr., Penna. Sys., Philadelphia, Pa.
Thomson, F. M., dist. engr., M. K. & T., Muskogee, Okla.
Tuthill, G. C., bridge engr., M. C., Detroit, Mich.
Vandersluis, W. M., elect. engr., Chgo. Ter. Imp., I. C., Chicago.
Van Houten, R. A., Sellers Manufacturing Company, Chicago.
Vawter, J., asst. prof. C. E., U. of I., Urbana, Ill.
Vitt, J. T., div. engr., Wabash, Springfield, Ill.
Wait, B. A., instman, C. R. I. & P., Des Moines, Iowa.
Wallace, D. A., 6 N. Michigan Ave., Chicago.
Warden, R. E., asst. engr., Mo. Pac., Little Rock, Ark.
Watt, J. R., gen. rdmstr., L. & N., Louisville, Ky.
Westcott, G. R., asst. engr., Mo. Pac., Poplar Bluff, Mo.
Wilks, J. R., asst. engr., C. R. I & P., Des Moines, Iowa.
Williams, C. C., prof. civil engrg., University of Illinois, Urbana, Ill.
Wiltsee, W. P., acting chf. engr., N. & W., Roanoke, Va.
Wood, B. A., chf. engr., M. & O., St. Louis, Mo.
Woodbury, W. H., val. engr., D. I. & R., and D. M. & N., Duluth, Minn.
Woods, A. A., chf. engr. maint. of way and structures, Southern, Cincinnati, Ohio.
Worthington, E. W., asst. engr., U. P., St. Louis, Mo.
Wynne, F. E., mgr. ry. equip. engrg. dept., Westinghouse Electric Company, East Pittsburgh, Pa.
Young, R. C., chf. engr., L. S. & I. and M., Marquette, Mich.

Guests

Adsit, C. R., asst. div. engr., B. & O., Akron, Ohio.
Basler, C., asst. gen. supt., Lorain Steel Co.
Boehne, E. E., International Creosoting & Construction Co., Galveston, Texas.
Beard, M. H., asst. div. engr., Akron, Ohio.
Bristow, J. W., U. S. R. R. A., Chicago.
Calvin, T. W., supvr. station service, B. & O., Cincinnati, Ohio.
Connelly, J. J., G. T., Montreal, Can.
Carvell, Hon. F. B., K. C., P. C., L. L. B., chf. commissioner of Canadian Railway Commission, Ottawa, Ont.
Cliese, Clement E., prin. asst. engr., Delaware River Bridge, Philadelphia, Pa.
Charleston, C. W., engr. acct., C. B. & Q., Lincoln, Neb.
Carver, A. R., div. engr., B. & O., Newark, O.
Cronin J. F. asst. engr., Okla. Ry. Co., Oklahoma City, Okla.
Edwards, D. W., Greenlee Bros. & Co., Washington, D. C.
Manley, R. S., pres., Creosoted Materials Co., New Orleans, La.
Cowsut, J. M., supvr. water dept., Mo. Pac., Gorham, Ill.
Davidson, C. R., trainmaster, Wabash, Forrest, Ill.
Dunstan J. H., Slidell, La.
Dunseth, John F., B. & O., Washington, Ind.
Espenshade, E. B., val. agt., C. & N. W., Chicago.
Ferguson, H., supt. tracks, Toronto, Can.
Gault, John J., Bucyrus Co., Chicago.
Gayner, 190 N. State St., Chicago.
Gilmore, R. W., asst. engr., B. & O., Dayton, O.
Grow, J. H., Engr. wood preservation, Allis Chalmers Mfg. Co., Milwaukee, Wis.
Hair, D. S., asst. engr., M. P., Illmo, Mo.
Henny, L. A., instrumentman, M. P., Little Rock, Ark.
Herman, B., asst. to v. p., Southern, Washington, D. C.
Hooper, E. L., div. engr., Penna., Grand Rapids, Mich.
Hughes, E. O., asst. val. engr., C. N., Van Wert, Ohio.
Kennedy, A. D., asst. engr., A. T. & S. F., Chicago.
McIlrath, J. A., asst. to gen. sec'y, American Railway Association, Chicago.
McGinity, T. J., Republic Creosoting Co., Indianapolis, Ind.
Main, J. P., gen. mgr., D. & T. S. L., Detroit, Mich.
Masters, F. M., consult. engr., Harrisburg, Pa.
Mann, J. R., supt. trans., D. & T. S. L., Detroit, Mich
May, A. D., asst. engr., M. P., Little Rock, Ark.

Nelson, H. W., pres., H. W. Nelson Co., Chicago.
Nicholson, C. J., asst. engr., T. H. & B., Hamilton, Ontario.
Normond, C. H., 116 W. Illinois st., Chicago.
Pollak, F. T., asst. engr., Frisco, St. Louis, Mo.
Potter, N. E., asst. engr., Wabash, Decatur, Ill.
Schmidt, asst. engr., A. T. & S. F., Chicago.
Smith, R. C., prin. asst. engr., M. & St. L., Minneapolis, Minn.
Stanley, J., asst. supt., Lorain Steel Co., Chicago.
Strehan, G. E., consult. engr., Southern Pine Association, New York City.
Strobel, C. L., Chicago.
Voorheis, J. D., supt. B. & B., Springfield, Ill.

Registration of Signal Section A. R. A.

THE FOLLOWING registered at the meeting of the Signal section, A. R. A., at the Drake Hotel yesterday, bringing the total list of members and guests for the two days to 487:

Representative Members

Annear, R. F., sig. supr., C. R. I. & P., 1737 "A" Ave., Des Moines, Iowa.
Barron, H., inspr. elec. sigs., St. L.-S. F., Springfield, Mo.
Butridge, J. H., chf. sig. inspr., I. C., 12th St. Sta., Chicago.
Carroll, P. H., sig. supr., B. & O., 941 Wayne St., Defiance, O.
Coleman, J. P., sig. supr., Grand Trunk, Durand, Mich.
Dayton, W. L., supr. sigs., Grand Trunk, Battle Creek, Mich.
Dean, W. A., sig. supr., P. & L. E., 1428 Fairlawn Ave., Pittsburgh, Pa.
Elsworth, R. B., asst. sig. engr., N. Y. C., Albany, N. Y.
Gault, P. M., office engr., I. C., Room 900, Central Sta., Chicago.
Hixson, C. W., supt. tel. & sigs., Penna., 323 W. Polk St., Chicago.
Hough, W. A., asst. sig. engr., Erie, 117 Park Ave., Paterson, N. J.
Kearton, T. H., supr. tel. & sigs., C. G. W., Mason City, Ia.
Kunker, J. W., sig. supr., B. & O., Cincinnati, O.
Little, W., supr. tel. & sigs., Penna., Pittsburgh, Pa.
McCreary, O. L., asst. supt. tel. & sigs., Penna., 160 W. Jackson Blvd., Chicago.
Mann., B. H., sig. engr., M. P., Room 1083, Ry. Exchange Bldg., St. Louis, Mo.
Mitchell, F. K., sig. inspr., P. & L. E., Pittsburgh, Pa.
Parker, C. W., sig. engr., Can. Pac., Windsor St. Sta., Montreal, Que.
Person, G. H., sig. supr., B. R. & P., Punxsutawney, Pa.
Phinney, R. M., asst. sig. engr., C. & N. W., 6300 N. Campbell Ave., Chicago.
Schroeder, J. M., sig. inspr., N. C. & St. L., Ft. Wayne, Ind.
Seifert, C. O., sig. supr., B. & O. C. T., Grand Cent. Station, Chicago.
Stillwell, W. H., sig. supr., L. & N., Paris, Ky.
Wass, F. E., supr. sigs., Grand Cent. Ter., Room 1612, New York.
Wesson, Eugene, office engr., C. B. & Q., 547 W. Jackson Blvd., Chicago.
Williams, J. F., sig. supr., C. C. C. & St. L., 2140 E. Main St., Springfield, O.

Railroad Affiliated Members

Punter, W. M., sig. engr., Can. Nor., Toronto, Ont., Canada.
Stansel, W. G., draftsman, J. C., Chicago.
Thompson, C. A., supr. sigs., B. & O., Relay, Baltimore County, Md.
Wilson, C. A., sig. maintr., C. R. I. & P., 1107 Cass St., Joliet, Ill.

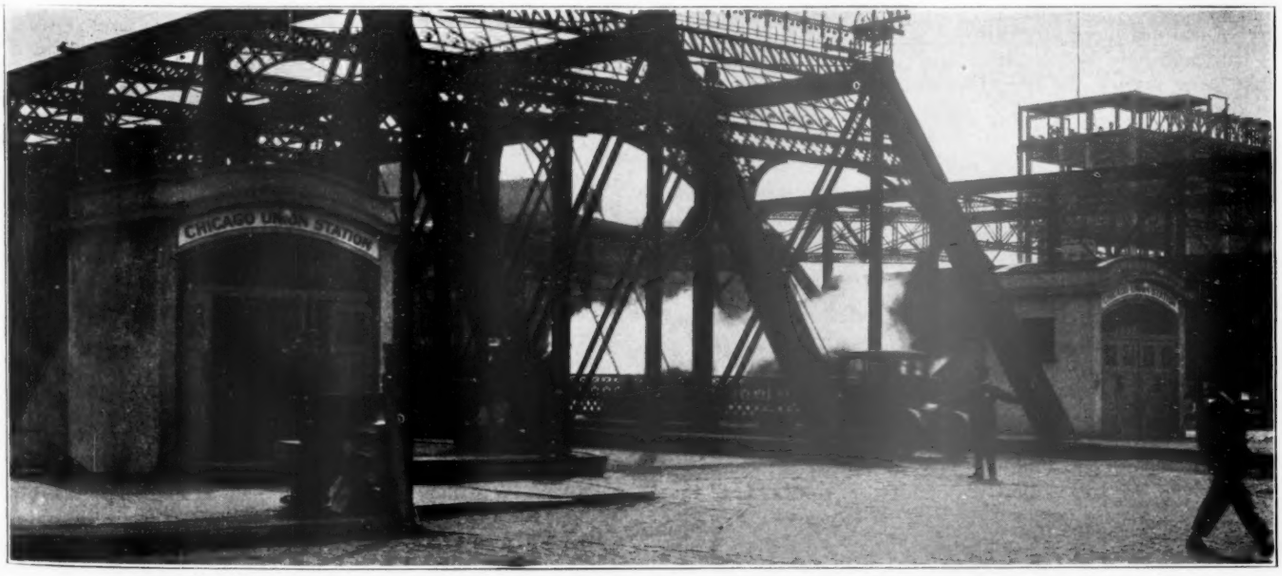
Affiliated Members

Blackmore, G. A., vice-pres., Union Switch & Signal Co., Swissvale, Pa.
Briney, M. R., eastern mgr., Federal Signal Co., 52 Vanderbilt Ave., New York.
Fitzgerald, J. M., The Gerald Co., 24 S. Clinton St., Chicago.
Henze, C. D. A., res. mgr., Federal Signal Co., 122 S. Michigan Ave., Chicago.
Marvin, W. S., spec. rep., French Bat. & Carbon Co., Madison, Wisc.
Renshaw, Paul, asst. pres., Federal Sig. Co., Albany, N. Y.
Richards, H. W., pres., Richards Ford Train Control Co., Baltimore, Md.
Roberts, J., ry. dept., General Electric Co., Schenectady, N. Y.
Shaver, A. G., cons. engr., Regan Safety Device Co., 857 Peoples Gas Bldg., Chicago.
Simmen, P. J., pres., Simmen Auto Ry. Sig. Co., Eden, N. Y.
Strickler, J. M., mgh., Track Material Sales, Ohio Brass Co., Mansfield, O.

Guests

Balliet, R. H. C., asst. sec'y, A. R. A., New York City.
Chamberlain, R. N., research engr., Gould Storage Battery Co., Chicago.
Cronin, V., reporter, A. R. A., New York City.
Griffith, S. A., fireman of Mt., Erie, Jersey City, N. J.
Harris, C. G., sig. inspr., N. & W., Roanoke, Va.
Hewes, R. W., mech. engr., Federal Signal Co., Albany, N. Y.
Immeshus, Carl, asst. chf. drftsmn., I. C.
Lasswell, W. S., sig. supr., B. & O., Grafton, W. Va.
Michley, J. K., engr., Union Switch & Signal Co., Wilkinsburg, Pa.
Morris, C. J., supr. tel. & sig., Penna., Akron, O.
Robinson, J. P., sig. engr., National Safety Appl. Co., Chicago.
Stone, E. W., const. engr., Nat. Safety Appl. Co., Chicago.

* * *



Kiosks for the Temporary Suburban Facilities on Canal Street at Jackson Boulevard Bridge, Chicago Union Station

Engineering Association Holds Annual Dinner

Canadian Railway Problems Principal Subject Discussed at the Banquet Last Night

THE AMERICAN RAILWAY ENGINEERING ASSOCIATION held one of its most successful dinners in the Gold Room of the Congress hotel last night, with an attendance of about 200. President Campbell presided. The speakers of the evening were: Hon. F. B. Carvell, chief commissioner, Board of Railway Commissioners for Canada, who talked on "The Canadian Railway Problems"; Floyd W. Parsons, editor and journalist, whose subject was "Looking Ahead" and Judge Harry V. Osborne, president, New Jersey Board of Public Utility Commissioners.

Hon. F. B. Carvell, K. C.

Floyd W. Parsons

After touching briefly on the cordial relations which have been maintained for many years between the United States and Canada, as well exemplified in the international character of the association, President Campbell introduced Mr. Carvell as the first speaker.

The Canadian Railway Problem

By Hon. F. B. Carvell

We have a most peculiar railway situation in Canada. We have at the present time—perhaps I should say we had—two railway systems of which we were justly proud, for a great many years. We had the old Grand Trunk, which was the father of all railway systems in Canada. Next to that we have now the Canadian Pacific. It might not loom as large in your eyes at is does in ours, but we believe that if all of the railway systems of the continent were as well managed, as well operated, and in as sound financial position as the Canadian Pacific, we would not have any railway problems to discuss.

But, against that, we have the Canadian National System, now owned by the Government of Canada, trying to operate 22,000 miles of railway at a tremendous disadvantage, because the operating expenses will run far behind the fixed charges, and of course dividends are out of the question. I dare say there are many people in Canada who believe in the principle of government ownership and operation of railways and other public utilities, but there are many people in Canada who do not believe in that doctrine, and it would be, I think, unwise for me to enter into any discussion of the facts here.

Suffice it to say, nearly 20 years ago there were two enterprising Canadians, Sir William McKenzie and Sir Donald Mann, who we all must admit were wizards in the construction and financing of railways. They started nearly 20 years ago with a short line north of Winnipeg, about 100 or 150 miles in length, I think, and they wound up a few years ago with some seven or eight thousand miles.

A few years after the Canadian Northern was started, the old Grand Trunk conceived the idea that it would become a trans-continental railway company. Political exigencies required that the road be constructed from the east, but not by the Grand Trunk, rather by the Government of Canada.

As time went on both of these railways fell into a crippled financial condition. They got along pretty well until the war, but when labor costs and the cost of materials commenced to go up they were unable to pay their way. The only thing to do then was either to let 400 million dollars of securities issued by the Canadian Northern default or take them over, and I want to tell you gentlemen it was a pretty serious thing for Canada when that problem was put up to the government. While there was a division of opinion among the members of the Canadian people themselves on this question, it was finally decided that the proper solution was for the government to take over this system.

We faced that situation and we faced it at a time when we were passing through the great war, when Canada, with a population of between eight and nine million people had a half million people on the firing line in France.

We don't know, gentlemen, where we are going to land in this adventure, but we believe we had a good man to take charge of that, a former American, many of you know him, Sir Henry Thornton. He has the loyal support of the Government. I feel sure of that. I feel he has the loyal support of his officers and his organizations. If I were as sure that we can get loyal work out of the workmen as I am that he can get it from his officers, there would not be much difficulty about it. The great fear that I have of the Government operation of railways, and I think it is borne out by your experience in the United States, is that men, while they may not be dishonest or intending to refuse to give the service, will not in the long run render the service that they would render to private corporations. I think that that is the real problem, the real difficulty in any government trying to run a railway or to operate any other utility requiring the employment of a large number of men. However, even on that question we feel confident that Sir Henry Thornton will meet with success.

Now, there is another phase of the railway question in Canada that is entirely in common with the railway question and the railway problem of the United States. Putting it very broadly, it is a question of how to get enough money in order to keep the thing running, and unfortunately for the last three years the burden seems to have fallen very largely on my shoulders to see how much money we will give to our railroads.

I don't know how it is with the people of the United States, but there are a great many people in Canada, especially among the farmer and lumber communities.

who have a most positive dislike to paying increased freight rates, and I am very much surprised if you did not find some of the same sentiment scattered around the United States (laughter).

Prior to 1915, we were getting along nicely. The C. P. R. was making money. On its railway operations it has always paid dividends of 7 per cent upon its common stock. There is no preferred stock in the Canadian Pacific Company.

The old Grand Trunk was paying its way, paying all its fixed charges, paying interest on the first, second and third preferred stock and paying some dividend every year on its common stock, but you all know what happened in 1915 and 1916, due to the war. The costs of labor commenced to go up, the railway employee could not live on the same amount of money that he had lived upon two or three years before. The costs of materials went up and in some cases almost doubled. There were some adjustments made until the month of March, 1918, when by order in council we gave the railways authority to increase their rates by 15 per cent. We thought that our troubles were all over with and we got along very well, although wages were going up at the same time. But August came along and Mr. McAdoo came along also. And what McAdoo didn't do to us in Canada! It has been nothing but one eternal round of trouble ever since, and I don't know where it is going to end.

McAdoo's Action Made Matters Worse

You may ask what Mr. McAdoo did over in Canada. It so happens that the railway systems in Canada are so interwoven with the railroad systems of the United States that our railway employees all belong to the same unions that your railway employees belong to, and therefore, no matter what is done in the United States, we are compelled to follow suit, and as soon as the McAdoo rates became effective in the United States, they automatically became effective in Canada. There was no way out of it. We increased the rates, too, and tried to follow you. We were getting along pretty well for a time, and then came the Railway Labor Board. And if anything was required to give us the knockout blow, it was the award which they gave in June. Your federal government, as I understand it, furnished the money which paid for the increased labor award. In our case there was no fairy godfather to pay the money, but the railways themselves had to take it up. However, on September 13, we were able to get our increase in rates effected about the same as yours. Yours was a 40 per cent increase. Ours was 40 per cent in the east only for four or five months. Then it went down to 35 per cent, but in spite of this our railways had to get enough money to pay the labor award of higher wages which was retroactive to the first of May.

Since I have been on the board we have tried to follow one principle, and no matter whether it is a popular or unpopular move, in my judgment, it must be followed if we are going to have anything like stability in the railway world of Canada or the United States. Of course, we leave out of the question entirely the government system of railroads, because, to a certain extent, it is made up in many cases of railways that you may say are for colonization purposes, which could not be expected to pay.

We have taken the Canadian Pacific as our standard, and I have endeavored, since I have been in a position to do so, to give a rate which will allow the Canadian Pacific to pay its operating expenses, its maintenance, its fixed charges, its pensions and its income tax (which amounts to something like four or five million dollars a year now) and then pay 7 per cent to its common stockholders. It just produced those results in the last four years.

We take the Canadian Pacific because it is a going concern, because, in our judgment, it is economically and efficiently operated. We laid down the principle that a public utility that is a live, going concern, that is economically and efficiently operated must receive a rate which will allow it to pay a reasonable dividend upon the invested capital. If you cannot get a rate of that kind, you cannot get the capital. You may say that is a pretty strong doctrine to lay down, but I have laid it down in my own country and I have no hesitation in laying it down here.

It would be highly improper if I were to make any reference to wages, and I am not going to do so. As I understand it, you have in the United States two boards. One is the Interstate Commerce Commission, which fixes the rates, and the other is the Labor Board, which fixes wages. Therefore, as both the rates and wages are fixed under the authority of your Congress, it must be assumed they are fixed properly, and I have no fault to find.

There are, however, certain incongruities in this great question, which cannot be settled as simply as I have passed them over this evening. In Canada we find a tremendous outcry against the increased rates, or continuance of increased rates. This is chiefly on the part of the rural population, the producers of grain in western Canada, producers of lumber and dealers in coal, pulp and paper manufacturers, and practically all people who are producing what you might call natural products. They have an idea that all their economic difficulties during the last two and one-half or three years have been brought about by the freight rates.

The Public's Complaint is Partly the Railroad's Fault

There is little doubt at all that there is a great gulf between the railway employees on the one hand and the producers and consumers in Canada and the United States on the other, and that gulf cannot be bridged by strikes and lockouts. It has got to be settled by some different means than we had in the past. Still, as I said before, you have a board here to settle those things, and therefore I cannot refer to them, but if I were to make a suggestion, I would say, that in my country some of the fault lies at the door of the railway companies. We are the same as you are, pretty reasonable when you put the whole facts of the case before the people. I believe that if the railway companies would take a little more interest than they have in the past and tell the whole story, it would be an easy matter to settle because I have usually found a great deal of common sense in people if you treat them fairly and approach them in the right way.

Now, I don't want to say anything more about our freight problem or our rate problem than that it is a real problem and I know it is a real problem with you and it is a problem which must be solved in some way. While I grant you that the freight rate is not the factor in the price which the producer receives for his product or which the consumer pays for it, although many people think it is, yet it is a factor and one which must be faced. It is not only a factor in dollars and cents but it is a factor in the dissatisfaction which must be faced.

It may be said that I have talked about freight rates in Canada and the United States, and what has that to do with engineers? It has more to do with engineers than perhaps you realize. I don't believe there is a gentleman within the sound of my voice tonight that would not like to have a few more hundred thousand dollars to spend on his railroad that he can get now. Everyone of you can realize that there is a great work to be

done by the engineering staff of the great railroads of the North American Continent, not only today but for all future time.

If I were to be called upon as to what in my judgment, is the greatest problem facing the engineers today, it is the safety of our highway crossings, the safety of the operation of our trains, and the providing of some means to make them even safer than they are today. The block signal system is good. We want an automatic train stop.

You have the deadly grade crossing, not half as deadly as some people think it is, but still deadly enough to kill a great many people in the course of a year. I do not know why it is that people will not stop for a railway crossing, but they won't, and therefore it seems to me the only thing to do is to protect these people against themselves.

The engineering features are not severe. They do not call for anything that all the gentlemen in this room do not know about, but they require money, just as the block signal requires money, just as the automatic train stop requires money, just as a hundred other things require money, and unless the rates are such that you can get the money to work with, then you have got to get it from the executives or from the sale of bonds or stocks, and if your rates are not sufficient you are going to find a tremendous problem in selling your securities.

Remarks by Mr. Parsons

Mr. Parsons spoke on some fallacies of the times.

We are ridiculous people. Our ideas of freedom are silly. We talk about free coal, of free coal industry, that we must not reduce an industry to slavery. We say that coal, being the basis of all energy, is as important as the mail. We might as well say that we cannot continue to make our mail trains operate as to let our coal mines shut down. Free air. The air is free. Yes. We pour into the air all the fumes and smells and discharges of the burning of lost coal all over the country. We lose $1.80 when we burn one ton of coal in any city in the country. We have isolated gas plants. Take a town of 6,000 houses, nearly every house has an isolated gas plant in it, and in that isolated gas plant, taking a ton of coal, you only get about 12,000 heat units effectively used in the cellar of your home. If you take that same coal and use it in a central plant and send it through pipes, through all the houses, you will get out above twenty million from a ton of coal.

In New York we have 4,200,000 h. p. in the form of water that is not being used. With one horse power equal to 10 tons of coal used, New York state's water power would be equivalent to 42,000,000 tons of coal and it would run every factory in the state of New York and require no coal at all in the manufacturing business in that state.

These are just a few little things that I am putting before you simply with the idea of making you think. It is really human to err, but it is diabolical to persevere in error. You know a lot of bad customs are like good cakes, they are better broken than kept. We stick to a whole lot of delusions and I am going to touch upon one or two. The worst delusion, perhaps, in the United States today, is the cycle theory, the idea that every time you have good business you must have bad, that action and reaction are equal. It is just as sensible to save when a man has been well five years that he is going to be sick five years. The fact is, that a man who has been well five years, is likely to be well for another five.

The curves of cycles cannot be entirely prevented, but the curve can be flattened out. It is wrong to assume that business cannot be permanently good. It is one thing that is wrong. It is a delusion that should be killed. It goes back to the days of Jacob and the seven fat years and the seven lean years.

Another delusion is connected with the Far East, that the balance of power is here in America. The truth is that the Far East will, I think, one day hold the balance of power. Some of the greatest scientists in the world come from India and China. They are mentally better students than we are. They work longer hours than we do. Don't forget that China today is as virgin as the United States was on the day that Columbus stepped on the shores of America. The balance of power, unless we watch out, will one day shift to the Far East.

I don't want you to think I am entirely pessimistic. I am merely engaged in a little constructive criticism. There is an old saying that a gem cannot be polished without friction. Neither can man.

Judge Osborne's Address

Judge Osborne spoke in part as follows:

The real danger signal today is the tendency of the times towards paternalism, i. e., to the paternalistic form of government. We are prone to forget that the strength and the vigor of this country had its source in individual qualities of the early settlers, and whether it is because of conditions we have brought upon ourselves or whether they have been forced upon us by social and economic conditions, the fact remains we are drifting towards what I consider a very undesirable goal. We are suffering from too much regulation of all kinds. You can scarcely turn about nowadays without violating some law or some ordinance or some regulation or some interpretation by virtue of the statute. Conditions are becoming intolerable, and I believe the greatest menace to the prosperity of the country today and its development and growth is this tendency to drift almost unconsciously into a position where we feel or think we must regulate everything and everybody.

That brings me, perhaps quite naturally, to the question of regulation of railroads by commissions. Some of you naturally think that it is very undesirable, but it is a condition that is here, and regulation today is a buffer between the old order and government ownership.

You have got to take your choice. If you do not have the regulation that we have today you are going to have the next worst thing, and that is government ownership. Regulatory bodies and officials ought to, and I believe most of them do, understand that it is not their job to operate the corporations, the public service corporations; that regulation does not mean undue interference; that they ought to and do realize that you trained men understand your jobs far better than any regulatory body ever can, and that they ought to leave it to you to see that that job is well and properly done. I think we appreciate the fact and know that you are making an honest, earnest and intelligent endeavor to produce the best results with the means at your command. We ought to and do try to foster a common understanding and a good will between the utility corporations, which include the railroads, and the public, so that we may have the confidence of the people, not only in the regulatory bodies which represent them but in the corporations themselves. It is only when we reach a point where we have reasonable regulation, intelligent regulation, and a regulation which inspires confidence of both corporations and the public that we will have successful regulation.

A. R. E. A. Committee to Co-operate with Colleges

THE BOARD OF DIRECTORS, of the American Railway Engineering Association, has appointed a committee to co-operate with the universities in the training of men for railway service, and in their employment on the roads following graduation. The scope of work outlined for this committee by the Board of Directors is to develop:

(1) A greater interest upon the part of railroad officers in assisting the universities to develop the best possible methods for the technical courses.

(2) A better means of bringing to the universities the results of our deliberations, where such can be made of value to them.

(3) A better means of bringing to the attention of the railroads the benefits of a technical education, thereby acquainting them with the qualifications of graduates of these courses for initial service in subordinate positions, and at the same time providing material from which men may be drawn for higher positions as they demonstrate their fitness.

(4) A means of stimulating a greater interest in the science of transportation among engineering students who may be inclined toward this branch of industry.

(5) A means whereby the facilities of the universities may be made more directly available for the research work of the association by co-operative effort between their laboratories and the committees of the association.

(6) A means whereby the universities may be better enabled to educate the students and the public regarding the value of transportation to the nation as a whole.

(7) A means of stimulating a greater interest among university officials in the study of transportation and economics and impressing them with the importance of experienced men for such teaching.

R. H. Ford, assistant chief engineer, of the Chicago, Rock Island & Pacific, has been appointed chairman of the committee, with the following as members: Begien, R. N., general manager, western lines, Cincinnati, Ohio; Cushing, W. C., engineer standards, Pennsylvania System, Philadelphia, Pa.; Fairbairn, J. M. R., chief engineer, Canadian Pacific, Montreal, Que., Faucette, W. D., chief engineer, Seaboard Air Line, Norfolk, Va.; Howson, E. T., western editor, *Railway Age*, Chicago; Katte, E. B., chief engineer electric traction, N. Y. C., New York City; Morse, C. A., chief engineer, C. R. I. & P., Chicago; Ray, G. J., chief engineer, D. L. & W., Hoboken, N. J.; Safford, H. R., vice-president, C. B. & Q, Chicago; Storey, W. B., president, A. T. & S. F., Chicago; Raymond, W. G., dean, College of Applied Science, State University of Iowa, Iowa City, Iowa., M. S. Ketchum, dean, College of Engineering, University of Illinois, Urbana, Ill.; Riggs, H. E., professor of civil engineering, University of Michigan, Ann Arbor, Mich.; Swain, G. F., professor, engineering school, Harvard University, Cambridge, Mass., and a member of the engineering faculty of the University of Toronto, Toronto, Ont.

The Central of Georgia has awarded a contract to the Ogle Construction Company for the erection of a reinforced concrete, electrically operated, coaling station at Macon, Ga., which will provide ground storage for 9,000 tons of coal, overhead storage for 600 tons of coal and 200 tons of wet sand and 35 tons of dry sand. The plant will have a hoisting capacity of 100 tons of coal an hour and it will be equipped with scales to record electrically the amount of coal delivered to locomotives.

An Apron for Discharging Ballast

THE WESTERN WHEELED SCRAPER COMPANY, Aurora, Ill., has recently added to its line of earth handling equipment for use in railway work, an accessory for air dump cars employed in distributing material intended for bank widening work. This device is known as the Western extension apron and is designed to meet the

A 20-Yard Air Dump Car Equipped with Extension Aprons About to Be Unloaded

problem arising where material is utilized for bank widening on ballasted track, of throwing the material outside the line of the ballast and thus prevent it from fouling the ballast.

As the name implies, the device is essentially a steel apron, so designed and fitted to the air dump car as to

The Same Car in the Dumping Position

afford an extension to the car floor on either side when in the dumping position. This apron hangs from the bed of the car by 10 cast steel hinges and is securely bolted to the car floor outside of the bed sills. The illustrations show the manner in which the apron works. When the car is in the upright position the apron hangs downward within the over-all clearance of the car,

while when the car is being dumped the apron on the dumping side moves out automatically, causing the load to be thrown beyond the ballast line. When in the dumping position the effect is that of extending the floor 28 in. during which the apron lies in a plane parallel to the car floor. When the car is righted the aprons move back into the vertical position, all movements taking place automatically with that of the dump car.

An Interesting Record of Motor Car Operation

SLIGHTLY MORE THAN A YEAR ago there was introduced in railway service by the Fairmont Gas Engine & Railway Motor Car Company, Fairmont, Minn. (now the Fairmont Motors, Inc.), a four horsepower inspection car carrying the name "Safety-Quick," which, aside from the center load feature, had as its prominent characteristics, (1) the unusually light weight of 385 lb.,

The "Safety Quick" Car on the A. B. & A.

thereby allowing it to be handled by one man; (2) a knockdown feature of construction whereby the power unit might readily be separated from the truck for shipment; (3) a spring mounting of the power unit to absorb the effect of bumping or vibration of the car during motion, and (4) safety guards on all four wheels. The car also embodies the feature of reinforced steel frame construction with wooden disc wheels and a cooling system of the automobile condensing type.

This car aroused considerable interest following its introduction and since that time has produced a number of interesting performance records in actual service. Recently performance data of unusual interest concerning the car has been afforded in a record disclosed by the Alabama, Birmingham & Atlantic in connection with one of these cars used by E. H. Pudney, signal engineer, and other officers for inspection work.

Immediately upon placing the car in service in February, 1922, the plan was instituted of obtaining records both of the number of miles traveled per day and the daily consumption of gasoline. This plan was followed until the end of January 1923, and gave these results:

Month—	Gals. Gasoline	Mileage
February	9.5	486
March	9	473
April	12	606
May	10	523
June	4	212
July	9.3	479
August	11	575
September	11.6	616
October	14	726
November	11.1	600
December	13	675
January	15	778
	129.5	6749

The car has thus been run 6,749 miles with a record of 52.11 miles per gal. of gasoline. The car carried an average of two men during the period and on occasions carried as many as four men over two per cent grades. Also during the period several non-stop runs of 125 miles were made.

A New Sand Dryer

THERE HAS BEEN INSTALLED in a number of coaling and sanding plants recently completed at various points a sand drying stove which relies on a number of fin-like projections on the body of the stove for its effectiveness in removing the moisture from the sand. These projections, of which there are five, placed one above the other as integral parts of the stove, have convex surfaces and are open on the underside, thus permitting the heat from the fire to come in direct contact with the wet sand around the stone, as well as through the increased metal surface. When dry the sand escapes through outlet holes in the base. The illustration is a view of the stove without the sand hopper. This is simply a steel plate which rests upon the rim shown in the photograph and extends outward to a height of three feet, the diameter of the top being 49½ in. As this hopper is conical in shape, it not only contains the sand but keeps feeding it against the stove as it is dried.

Constructed in the manner described, the dryer is said to be capable, with a good grade of sand, of producing

The Perfection Dryer with the Hopper Removed to Show the Fins

12 tons of dry sand per 24 hours. In one installation it is said the dryer operated 24 hours a day for nine months and 13 days, at the end of which time the stove required only the renewal of the grate. The stove complete weighs 1,300 lb. and is known as the Perfection Cone Stove Sand Dryer, of which the Roberts & Schaefer Company, Chicago, is the distributor. At the present time, two of the stoves are in use on the Michigan Central at Michigan City, Ind., and one on the Chesapeake & Ohio at Peach Creek, Va.

As a result of numerous inquiries relative to the course pursued by different railway organizations in preparing A. F. E.'s and resulting completion reports, a meeting was called for those interested to discuss the subject informally, following the close of the regular afternoon session yesterday.